

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:

MERLONI ELETTRODOMESTICI SpA
Ufficio Brevetti e Marchi
Attn. Dini, Roberto
Via Pinerolo 25
I-10060 NONE (TO)
ITALY

Date of mailing
(day/month/year)

22/08/2000

Applicant's or agent's file reference

ME017

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/IB 00/00097

International filing date
(day/month/year)

01/02/2000

Applicant

MERLONI ELETTRODOMESTICI S.P.A. et al.

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority

European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31.651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Patricia Klingens-Herklots

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NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

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NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments and any accompanying statement, under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the time of filing the amendments (and any statement) with the International Bureau, also file with the International Preliminary Examining Authority a copy of such amendments (and of any statement) and, where required, a translation of such amendments for the procedure before that Authority (see Rules 55.3(a) and 62.2, first sentence). For further information, see the Notes to the demand form (PCT/IPEA/401).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

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PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)

To: Dini, Roberto MERLONI ELETTRODOMESTICI SPA Ufficio Brevetti e Marchi Via Pinerolo 25 I-10060 None (TO) ITALIE
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Date of mailing (day/month/year)	08.10.2001
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Applicant's or agent's file reference ME017

IMPORTANT NOTIFICATION

International application No. PCT/IB00/00097	International filing date (day/month/year) 01/02/2000	Priority date (day/month/year) 28/06/1999
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Applicant WRAP S.P.A. et al.
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1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/ <div style="display: flex; align-items: center;"> <div> European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 </div> </div>	Authorized officer Ottaviani, P Tel. +49 89 2399-2225
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference ME017	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/ IB 00/ 00097	International filing date (day/month/year) 01/02/2000	(Earliest) Priority Date (day/month/year) 28/06/1999
Applicant MERLONI ELETTRODOMESTICI S.p.A. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

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☐ None of the figures.

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference ME017	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB00/00097	International filing date (day/month/year) 01/02/2000	Priority date (day/month/year) 28/06/1999
International Patent Classification (IPC) or national classification and IPC H02J3/14		
Applicant WRAP S.P.A. et al.		



- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 8 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 18/01/2001	Date of completion of this report 08.10.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Drysdale, N Telephone No. +49 89 2399 2435 

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/00097

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):
- Description, pages:**

1-32 as originally filed

Claims, No.:

1-32 as received on 22/08/2001 with letter of 11/08/2001

Drawings, sheets:

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/00097

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 2-25, 28, 30-32
	No: Claims 1, 26, 27, 29
Inventive step (IS)	Yes: Claims 2-20, 22, 28, 31
	No: Claims 1, 21, 23-27, 29, 30, 32
Industrial applicability (IA)	Yes: Claims 1-32
	No: Claims

2. Citations and explanations
see separate sheet

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V. Reason d statement

2. Citations and explanations

1. Reference is made to the following document:

D1 = EP 0 727 668 A

D2 = DE 195 30 826 C

D3 = US 4 471 232 A

D4 = EP 0 750 383 A.

Documents D1, D3 and D4 are not listed in the international search report. D1 claims the priority of the Italian patent IT 01 279 545, cited on page 2 of the present description. Copies of D3 and D4 are attached to this report.

2. The application includes four independent claims, viz. Nos. 1, 23 & 26 directed to a method for managing electric power consumption of a users system (i.e. a system of users, or loads) and No. 29 directed to a users system.
3. It appears to be an important feature of the claimed method (claim 1) and system (claim 29) that there is no central unit controlling the smart users, each user having instead its own control system (SC). Of the available documents, the applicant's own D1 is the only one disclosing this feature, and therefore appears to represent the closest prior art. D1 clearly discloses the preambles of claims 1 and 29. However, it appears that D1 also discloses their characterising parts.
4. Taking claim 29 first, its characterising portion specifies that the control system (associated with each smart user) comprises "means (TB6, TB7, TB8) for calculating a priority value (PRD) in function of the state of the associated smart user (UI)". However, it is clearly stated in D1 that the energy consumption management effected by the control systems (SC) involves consideration of priority rules that are defined among the different domestic appliances (col. 3, lines 9-15), that household appliances have different operational phases during which their electric current absorptions are different (col. 7, lines 7-10), that each intelligent household appliance declares constantly on to the common communication bus its **instant** consumption of electrical energy (col. 7, lines 17-20) and that such informa-

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tion is advantageously represented by the **priority I v I** of the appliance (col. 7, lines 22-25). D1 is the present applicant's own document, and the applicant asserts that the priorities in D1 are fixed. However, the examiner considers that the passages cited above would be interpreted by a skilled person as meaning that each domestic appliance has a basic, fixed priority, according to which, for example, a hot plate or an oven for cooking might have a higher priority than a washing machine, but that this fixed priority is modified according to the operating state of the appliance expressed in terms of its instantaneous energy consumption, so that the priority of the oven, for example, would be reduced if it had already attained its operating temperature and could therefore tolerate being switched off for a short period, thus yielding a time-dependent dynamic priority, in the terminology of the present application.

The subject-matter of claim 29 is therefore deprived of novelty by the disclosure of D1 (Art. 33(2) PCT).

5. The characterising part of claim 1 refers to the "priority value (PRD, PriorEff)". However, reference signs such as PRD and PriorEff do not limit the scope of a claim.

The subject-matter of claim 1 is therefore also not new in the light of the teaching of D1 (Art. 33(2) PCT).

6. With respect to dynamic priority attention is directed to document D2. D2 discloses a method for managing electric power consumption of a system comprising 3 smart users (1-3) (Fig. 1). If an overload situation develops, the users are intermittently switched off and switched on again in accordance with assigned priorities (col. 6, lines 12-28). D2 recognises that the tolerance of users to being switched off depends on the stage reached in their operational cycle, in particular, on how much energy they have already stored. In the control system according to D2 a computer recalculates the priorities of the users at predetermined intervals, using a computer model to simulate the heat storage behaviour of each individual user (col. 6, line 50 - col. 7, line 8). D2 thus clearly teaches a skilled person that the priority of a user may vary with time, in order to optimise the power consumption of a system of users, and it would be obvious to apply the same principle to the system of D1.

The subject-matter of claims 1 and 29 therefore independently lacks an in-

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ventive step (Art. 33(3) PCT) in the light of the combined teaching of D1 and D2.

7. Claim 26 concerns a method for managing electric power consumption of a users system, where each user (UI) is associated to a priority (PriorEff, PRD) for access to energy consumption, characterized in that each smart user (UI) is provided to autonomously define its own Dynamic Priority (PRD) as a function of the operating state of the user (UI) itself and environment information. The term "dynamic priority" has no generally accepted meaning in the art, and therefore requires definition in the claims to satisfy the requirement of Art. 6 PCT (clarity). The definitions provided in claim 27 are optional features ("such as ..."). There is at present no reason not to identify the "dynamic priority" of the claims with the time-varying priority which, in the examiner's opinion, is disclosed in D1 - see section 4 above.

The subject-matter of claims 26 and 27 is therefore not new (Art. 33(2) PCT), or lacks an inventive step (Art. 33(3) PCT) in the light of the teaching of D2.

8. Claim 23 concerns a method for managing electric power consumption of a users system, where each user has an associated priority (PriorEff) for access to energy consumption, characterized in that said priority (PriorEff) is used to initialise a timer (TP) in a proportional mode to said priority (PriorEff) and let the user (UI), whose relevant timer (TP) will first terminate its own count, have access to energy consumption. The same principle is contained in claim 30.
9. Document D3 discloses a method for managing electric power consumption of a system of users (domestic appliances). The power consumed by the system is sampled at regular intervals by a current transformer (30) (Fig. 1) and, if demand exceeds a permitted maximum ($PD < 0$ in the terminology of the present application), an impulse is transmitted on the supply line. This pulse is detected by counters (45) forming part of respective control units (40) associated with each smart load (12-14). Additional pulses will be transmitted each time the current is sampled as long as the overload situation persists, causing the counts in each counter (45) to accumulate. If no pulse is detected within a period corresponding to the sampling interval, the counters are decremented by "1". When the accumulated counts in a counter exceed a predetermined number stored in a memory of the control unit (40), supply to the associated load is cut off, and remains off until the accumulated counts again fall below the predetermined number. This number

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represents the priority of the associated load (col. 6, line 29 to col. 7, line 51; col. 8, lines 18-44).

The concept of embodying the priority of a load as a limit for a counter is thus known from D3. In the light of this teaching the subject-matter of claims 23 and 30 does not involve an inventive step (Art. 33(3) PCT).

10. According to claim 21 each smart user takes a dynamic priority value different from that of every other smart user. This is also recommended in D3 (col. 2, lines 63-64). The subject-matter of claim 21 does not, therefore, involve an inventive step (Art. 33(3) PCT).
11. Claims 24 & 25 concern technical details of the implementation of the method according to claim 23 lying within the normal competence of a skilled person. The subject-matter of claims 24 & 25 cannot, therefore, be considered as involving an inventive step (Art. 33(3) PCT).
12. According to present claim 32 the control system is associated to sound and/or visual display means. This is a normal measure in the art. Document D4, for example, discloses an energy management system comprising visual and audio warning means (5, 6) to give notice of an imminent overload situation.

The subject-matter of claim 32 does not, therefore, involve an inventive step (Art. 33(3) PCT).
13. The method and system as disclosed in the application, i.e. comprising an Effective Priority (PriorEff), which starts from a value of a Dynamic Priority (PRD) and evolves with time until a predetermined limit is reached, appears to be novel and to involve an inventive step in the light of the available prior art. However, claim 2 should have been clarified and completed so as to include all the essential features of the invention (Art. 6 PCT). In such a clarification attention should have been paid to the fact that the term "state" of the user seems to be used in two different senses in the claims, a first sense meaning a programme step, or the like, of the user appliance (cf. claim 27) and a second sense meaning the states (S.1 - S.9) of Figs. 2-3. In claim 6 the latter states are referred to as "logic states", which does not seem appropriate, since logic states are characterised by logical values ("True", "False") of variables.

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14. It appears that claim 2 should have read along the following lines:
A method for managing electric power consumption of a system of users according to claim 1, characterized in that said priority value (PriorEff) is obtained at least by evaluating a dynamic priority (PRD) that is a function of the state of the associated smart user (UI) [by which the examiner understands "state" in the sense of claim 27], and using said dynamic priority (PRD) as a starting value for a counter associated with the corresponding smart user (UI), the said counter being incremented and/or decremented in time until a predetermined limiting value is reached, at which point the associated smart user (UI) is admitted to a competition procedure within the set of smart users for accessing the available power, the value of the count at any time giving the value of the priority (PriorEff), which thus determines the order in which the members of the set of smart users may access the available power.
15. On the assumption that claim 2 is to be understood along the general lines set out above, its subject-matter is new and involves an inventive step (Art. 33(2) & (3) PCT).
16. Claims 3 to 20 and 22, which depend directly or indirectly on claim 2 (claim 22 refers to a power packet, which is introduced in claim 2), define advantageous embodiments of the method of claim 2. Their subject-matter is therefore also novel and inventive (Art. 33(2) & (3) PCT).
17. According to claims 28 and 31 Dynamic Priority (PRD) is determined through elaboration circuits operating according to fuzzy logic principles. This feature is not disclosed or suggested by any available document. The subject-matter of claims 28 and 31 is therefore to be regarded as satisfying the requirements of Art. 33(2) & (3) PCT.
18. Industrial applicability (Article 33(4) PCT) is obvious for all claims.

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P. ENT COOPERATION TREA

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

DINI, Roberto
Merloni Elettrodomestici S.p.A.
Ufficio Brevetti e Marchi
Via Pinerolo, 25
I-10060 None
ITALIE

Date of mailing (day/month/year) - 16 March 2001 (16.03.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference ME017	
International application No. PCT/IB00/00097	International filing date (day/month/year) 01 February 2000 (01.02.00)

1. The following indications appeared on record concerning:		
<input checked="" type="checkbox"/> the applicant	<input type="checkbox"/> the inventor	<input type="checkbox"/> the agent <input type="checkbox"/> the common representative
Name and Address MERLONI ELETTRODOMESTICI S.P.A. Viale Aristide Merloni, 47 I-60044 Fabriano Italy	State of Nationality IT	State of Residence IT
	Telephone No. 39 11 9904174	
	Facsimile No. 39 11 9904182	
	Teleprinter No.	
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:		
<input type="checkbox"/> the person	<input checked="" type="checkbox"/> the name	<input type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence
Name and Address WRAP S.P.A. Viale Aristide Merloni, 47 I-60044 Fabriano Italy	State of Nationality IT	State of Residence IT
	Telephone No. 39 11 9904174	
	Facsimile No. 39 11 9904182	
	Teleprinter No.	
3. Further observations, if necessary:		
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The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Ingrid Aulich
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P ENT COOPERATION TREA

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
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 in its capacity as elected Office

Date of mailing (day/month/year) 20 February 2001 (20.02.01)	
International application No. PCT/IB00/00097	Applicant's or agent's file reference ME017
International filing date (day/month/year) 01 February 2000 (01.02.00)	Priority date (day/month/year) 28 June 1999 (28.06.99)
Applicant MELONI, Francesca	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 18 January 2001 (18.01.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Pascal Piriou Telephone No.: (41-22) 338.83.38
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Via Pinerolo 25
10060 None (TO)

**CONFIRMATION
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**EUROPEAN PATENT OFFICE
Directorate General 2
D - 80298 Munich
GERMANY**

None (TO), Italy, August 11, 2001

PCT Patent Application PCT/IB00/0097
Response to PCT Written Opinion under PCT R. 66
Applicant reference: ME017

Reference is made to the Written Opinion under Rule 66 PCT dated 06.04.2001, which has been carefully considered.

We herein enclose a new set of amended claims and some considerations thereof, in order to possibly overcome the Examiner's objections.

New claims

The new claim 1 is based on original claim 1 and 4 and description, page 6 lines 10-14.

New claim 4 is based on description page 9 line 28 to page 10 line 2, page 12, lines 9-15.

New claim 29 is based on original claim 29 and description, page 6 lines 10-14.

The amendments aim to highlight that the gist of the invention resides in the fact that the operation is based on a calculation of a priority value that changes with respect to the operating status and other parameters of the appliance;

Amendments in the dependent claims has been introduced in order to clarify the language, as required by the Examiner under point 5.

2. Novelty

Document (D1) EP 0 727 668 substantially corresponds to

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Italian patent IT 01 279 545 cited on page 2 of the present description.

While it is highly appreciated that the Examiner has recognized the specificity of a system without a master control unit, nevertheless we have to disagree with the interpretation of the disclosure of document D1.

The system disclosed in D1, as stated by the Examiner under point 4, teaches to assign priorities to the appliances and this have been introduced in preamble of claim 1.

The system disclosed in D1 does not teach that 'said priority value (PRD, PriorEff) is calculated by the control system (SC) in function of the state of the associated smart user (UI),' as claimed in claim 1.

Document D1 disclose appliances with fixed priorities.

In fact, the indicated reference in column 3, lines 9-15, simply states that the distribution of energy is dynamical, not priority, and that the priority rules are to be optimized in function of the type of the household appliances that are active time by time.

The reference to column , 1. line 53 to col 7. line 16 simply says that the washing machine LS can operate when the oven FO is in pause, i.e. it is not consuming power. The successive hint to manage with cleverness the single phases that have different current absorptions in no way indicates that the priority is variable, but clearly indicates by the use of the expression 'time-sharing', that a time division according to the fixed priorities is sought.

The following paragraph, col. 7 lines 16 to 25, gives an explanation for this. The appliance broadcast its instant consumption and/or information that is operating or not; the latter can be represented by the "priority level of the electric appliance established on the basis of standardized rules". This means that the priority is fixed and rules of interpretation are built in the controller in order to manage the different priority declarations on the communication network.

Thus claim 1 is novel over D1.

For the same reasons it can be said that the system disclosed in document D1 comprises "means (TB6, TB7, TB8) for calculating a priority value (PRD) in function of the state of the associated smart user (UI)", since there the priority is fixed.

Thus claim 29 is novel over D1.

Therefore new claim 1 and 29 are novel over document D1.

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3. Inventive step

We agree with Examiner's opinion that document D1 constitutes the closest prior art

Starting from the closest prior art disclosed in EP 0 727 668, the objective technical problem underlying the present invention is to provide a method for managing electric power consumption of a users system which avoids exceeding a predetermined power threshold globally absorbed by said set of smart users, controlling their consumption on the basis of their own rules and internal information as well as on regular information supplied by a central unit.

The above problem is solved by a method that provides the smart users with a controller that calculates a priority value in function of the state of the associated appliance, and uses this priority value to define the right to access to the available power.

This solution is not obvious for the following reasons:

the man skilled in the art, faced with the problem of providing a method for managing electric power consumption of a users system which avoids exceeding a predetermined power threshold globally absorbed by said set of smart users, controlling their consumption on the basis of their own rules and internal information as well as on regular information supplied by a central unit would not have arrived to the arrangement disclosed in the application in reference.

Document D1 clearly hints to use a time sharing mode, inserting standardized rules for managing the fixed priority.

It is therefore submitted that the claimed method and system were not obvious to a skilled person.

Hence the subject matter of the Claim 1 and Claim 29 implies an inventive step with regard to the cited prior art and therefore satisfies Art. 33(1) PCT.

We should be pleased to receive the a second opinion with the Examiner's suggestions for the drafting of new claims, in the case that the enclosed ones would still be judged as not complying with the PCT.

With kindest regards,

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Ing. Roberto DINI
In charge of patents

encl: .
New set of claims

A handwritten signature in black ink, appearing to read 'Roberto Dini', is written over the typed name.

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REPLACED BY
ART 34 AMDT

CLAIMS

1. A method for managing electric power consumption of a users systems, said users system comprising:
 - a set of users (U), comprising in turn a set of smart users (UI) equipped with control systems (SC), said set of users (U) being operatively connected to a power supply network (RE);
 - power measuring means (CE, NM), capable of transmitting information on power consumption (PD) to said control systems (SC);where the control systems (SC) perform power consumption control of the associated smart user (UI) on the basis of information on power consumption (PD) transmitted by the power measuring means (CE, NM) by the power measuring means (CE, NM), characterized in that each control system (SC) performs power consumption control of the associated smart user (UI) on the basis of the information on power consumption (PD) and of information on the state of the associated smart user (UI) obtained from the control system itself (SC), said information on power consumption (PD) and state information (PriorEff) of the smart user (UI) being processed for determining a priority (PriorEff), so as to establish right for the associated smart user (UI) to the consumption of power packets (ΔP) available from the power supply network (RE).
2. A method for managing electric power consumption of a users systems according to claim 1, characterized in that it employs said priority (PriorEff) as a starting value allocated to each respective smart user (UI) in a competition procedure (S.2, S.6, S.7) within the set of smart users (UI).
3. A method for managing electric power consumption of a users systems according to claim 2, characterized in that said priority (PriorEff) is made variable in time as a function of state information (PRD).
4. A method for managing electric power consumption of a users systems according to claim 3, characterized in that said priority (PriorEff) is obtained based on a Dynamic

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Priority (PRD) value, which is part of the state information of the smart user (UI).

5. A method for managing electric power consumption of a users systems according to claim 4, characterized in that said priority (PriorEff) is employed for controlling time counting means (YP), which cause the value of said priority (PR) to evolve for performing a competition procedure (S.2, S.6. S.7).
6. A method for managing electric power consumption of a users systems according to claim 5, characterized in that in line with determined values taken by the information on Power Consumption (PD), the system control (SC) goes over to a Competition for Increment State (S.2, S.6), reducing energy consumption at the same time.
7. A method for managing electric power consumption of a users systems according to claim 6, characterized in that in said Competition for Increment State (S.2, S.6), the control system (SC) evaluates Power Consumption (PD) information at the end of Priority evolution (PriorEff) dictated by the time counting means (TP) to establish subsequent transitions (T.2, T.3, T.4, T.16, T.20, T.21, T.22, T.23).
8. A method for managing electric power consumption of a users systems according to claim 7, characterized in that said subsequent transitions (T.2, T.3, T.4, T.16, T.20, T.21, T.22, T.23) are also established based on power threshold values (K0, K1, K2, K3, K4, K5) stored in the control system (SC).
9. A method for managing electric power consumption of a users systems according to claim 8, characterized in that said power threshold values ((K0, K1, K2, K3, K4, K5) are adjustable.
10. A method for managing electric power consumption of a users systems according to claim 8, characterized in that said power threshold values (K0, K1, K2, K3, K4, K5) can be adjusted individually for each smart user (UI).
11. A method for managing electric power consumption of a users systems according to claim 7, characterized in that subsequent transitions comprise taking (T.2, T.22) a packet of available power (ΔP) from the supply network (RE).
12. A method for managing electric power consumption of a users systems according to

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claim 7, characterized in that subsequent transitions comprise a transition (T.3) in a QUIESCENT State (S.4)

13. A method for managing electric power consumption of a users systems according to claim 12, characterized in that in said QUIESCENT State (S.4) priority (PriorEff) is
5 reset and subsequently incremented at constant rate.

14. A method for managing electric power consumption of a users systems according to claim 2, characterized in that power consumption of a smart user (UI) is reduced through deactivation.

15. A method for managing electric power consumption of a users systems according to
10 claim 6, characterized in that in line with second determined values taken by the information on power consumption ($PD < K2$) the control system (SC) goes over to a Competition for Decrement State (S.2), so as to reduce energy consumption.

16. A method for managing electric power consumption of a users systems according to
15 claim 15, characterized in that in said Competition for Decrement state (S.6) time counting means (TP) cause the priority (PriorEff) to evolve in an opposite direction to the evolving of the Competition for Decrement State (S.7).

17. A method for managing electric power consumption of a users systems according to claim 15, characterized in that in said Competition for Decrement State (S.6) a user (UI), whose time counting means (TP) reach count end, may choose to execute a
20 transition (T.14) wherein a power packet (ΔP) is released).

18. A method for managing electric power consumption of a users systems according to claim 5, characterized in that in line with determined information values about available power (PD), the users (UI) having a priority (PriorEff) below a fixed threshold are immediately deactivated.

25 19. A method for managing electric power consumption of a users systems according to claim 5, characterized in that in line with determined information values on Available Power (PD), the users (UI) with a priority (PriorEff) below a threshold associated to available power (PD) information are immediately deactivated.

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20. A method for managing electric power consumption of a users systems according to claim 2, characterized in that the control system (SC) of each smart user (UI) is allowed to use Reduced Load strategies and/or Reduced Consumption strategies.
- 5 21. A method for managing electric power consumption of a users systems according to one of the previous claims, characterized in that each smart user (UI) takes dynamic priority values (PRD) differing from the values of each other smart user (UI) to hinder the set of users (UI) from entering oscillation situations.
- 10 22. A method for managing electric power consumption of a users systems according to one of the previous claims, characterized in that each smart user (UI) draws a power packet (ΔP) in a different instant to hinder the set of users from entering oscillation situations.
- 15 23. A method for managing electric power consumption of a users systems, where each user has an associated priority (PriorEff) for access to energy consumption, characterized in that said priority (PriorEff) is used to initialise a timer (TP) in a proportional mode to said priority (PriorEff) and let the user (UI), whose relevant timer (TP) will first terminate its own count, have access to energy consumption.
- 20 24. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that the Priority Timer (TP) is obtained through a counter employing a higher number of bits than the number of bits employed for defining the priority (PriorEff).
- 25 25. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that it uses the most significant bits (P8 ... P1) of the Priority Timer (TP) for representing the priority (PriorEff) and the less significant bits (I3, I2, I1) for a second temporary scansion.
26. A method for managing electric power consumption of a users systems, where each user (UI) is associated to a priority (PriorEff, PRD) for access to energy consumption, characterized in that each smart user (UI) is provided to autonomously define its own Dynamic Priority (PRD) as a function of the operating state of the user

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(UI) itself and environment information.

27. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that dynamic priority (PRD) is defined as a function of information, such as user service duration and/or program in course and/or a program step and/or remaining time to end the step and/or possible program reconfiguration to request less power and/or consumer's habits and/or timetable for service to end and/or electric low-rate timetables.

28. A method for managing electric power consumption of a users systems according to claim 26 or 27, characterized in that Dynamic Priority (PRD) is determined through elaboration circuits operating according to fuzzy logic principles.

29. A users' system comprising a set of users (U), which comprises in turn a set of smart users (UI), with control systems (SC), said set of users (U) being operatively connected to an energy supply network (RE) and comprising, moreover, energy measuring means (CE, NM) apt to transmit information on energy consumption (PD) to said control systems (SC), where said control means (SC) perform autonomously energy consumption control of the associated smart user (UI) based on the information on energy consumption (PD) transmitted by the energy measuring means (CE, NM), characterized in that said control system (SC) comprises means (TB6, TB7, TB8) for processing a priority value (PRD).

30. A users system according to claim 26, characterized in that the control system (SC) comprises time counting means (TP) for performing a count based on the priority value (PRD).

31. A users system according to the previous claim, characterized in that the control system (SC) comprises logic fuzzy elaboration circuits for determining the dynamic priority (PRD) value.

32. A users system according to the previous claim 26, characterized in that said control system (SC) is associated to sound and/or visual displaying means to signal information on energy consumption (PD).

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CLAIMS

1. A method for managing electric power consumption of a users system, said users system comprising:

- a set of users (U), comprising in turn a set of smart users (UI) equipped with control systems (SC), said set of users (U) being operatively connected to a power supply network (RE);
- power measuring means (CE, NM), capable of transmitting information on power consumption (PD) to said control systems (SC);

where to each smart user (UI) is associated a priority value (PRD, PriorEff) that defines its right to access power under the control of the control systems (SC) jointly with the information on power consumption (PD) transmitted by the power measuring means (CE, NM)

characterized in that

said priority value (PRD, PriorEff) is calculated by the control system (SC) in function of the state of the associated smart user (UI),

the control system(SC) uses said priority value (PRD, PriorEff) to decide the right to access for the associated smart user (UI) to the power consumption (PD) available from the power supply network (RE).

2. A method for managing electric power consumption of a users systems according to claim 1, characterized in that that said priority value (PRD, PriorEff) is obtained at least by evaluating a dynamic priority (PRD), that is function of the state of the associated smart user (UI), using said dynamic priority (PRD) as starting value allocated to each respective smart user (UI) to calculate an effective priority (PriorEff) that the associated smart user (UI) uses as a counter in a competition procedure (S.2, S.6, S.7) within the set of smart users (UI) for accessing the available power packets before the other smart users (UI).

3. A method for managing electric power consumption of a users systems according to claim 2, characterized in that said priority (PriorEff) evolves in time as a function of

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dynamic priority (PRD).

4. A method for managing electric power consumption of a users systems according to claim 3, characterized in that a power consumption (Pot[i]) required by the smart user (UI) is subdivided in power packets (ΔP) and in that the control system(SC) uses said
5 priority value (PRD, PriorEff) to decide the right to access for the associated smart user (UI) to the consumption of power packets (ΔP) that are part of the power consumption (PD) available from the power supply network (RE).
5. A method for managing electric power consumption of a users systems according to claim 4, characterized in that said effective priority (PriorEff) is employed for
10 initializing time counting means (TP), which cause the value of said priority (PriorEff) to evolve for performing said competition procedure (S.2, S.6. S.7).
6. A method for managing electric power consumption of a users systems according to claim 5, characterized in that the competition procedure (S.2, S.6. S.7) comprises a set of logic states and in that, in line with determined values taken by the information on
15 Power Consumption (PD), the system control (SC) goes over to a Competition for Increment State (S.2, S.6), , reducing energy consumption at the same time.
7. A method for managing electric power consumption of a users systems according to claim 6, characterized in that in said Competition for Increment State (S.2, S.6), the control system (SC) evaluates Power Consumption (PD) information at the end of
20 Priority evolution (PriorEff) dictated by the time counting means (TP) to establish subsequent transitions (T.2, T.3, T.4, T.16, T.20, T.21, T.22, T.23) among the states.
8. A method for managing electric power consumption of a users systems according to claim 7, characterized in that said subsequent transitions (T.2, T.3, T.4, T.16, T.20, T.21, T.22, T.23) are also established based on power threshold values (K0, K1, K2, K3, K4, K5) stored in the control system (SC).
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9. A method for managing electric power consumption of a users systems according to claim 8, characterized in that said power threshold values ((K0, K1, K2, K3, K4, K5) are adjustable.

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10. A method for managing electric power consumption of a users systems according to claim 9, characterized in that said power threshold values (K0, K1, K2, K3, K4, K5) can be adjusted individually for each smart user (UI).
11. A method for managing electric power consumption of a users systems according to claim 7, characterized in that subsequent transitions comprise taking (T.2, T.22) a packet of available power (ΔP) from the supply network (RE).
12. A method for managing electric power consumption of a users systems according to claim 7, characterized in that subsequent transitions comprise a transition (T.3) in a QUIESCENT State (S.4)
13. A method for managing electric power consumption of a users systems according to claim 12, characterized in that in said QUIESCENT State (S.4) priority (PriorEff) is reset and subsequently incremented at constant rate.
14. A method for managing electric power consumption of a users systems according to claim 2, characterized in that power consumption of a smart user (UI) is reduced through deactivation.
15. A method for managing electric power consumption of a users systems according to claim 6, characterized in that in line with second determined values taken by the information on power consumption ($PD < K2$) the control system (SC) goes over to a Competition for Decrement State (S.2), so as to reduce energy consumption.
16. A method for managing electric power consumption of a users systems according to claim 15, characterized in that in said Competition for Decrement state (S.6) time counting means (TP) cause the effective priority (PriorEff) to evolve in an opposite direction to the evolving of the Competition for Decrement State (S.7).
17. A method for managing electric power consumption of a users systems according to claim 15, characterized in that in said Competition for Decrement State (S.6) a user (UI), whose time counting means (TP) reach count end, may choose to execute a transition (T.14) wherein a power packet (ΔP) is released).
18. A method for managing electric power consumption of a users systems according to

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claim 5, characterized in that in line with determined information values about available power (PD), the users (UI) having a effective priority (PriorEff) below a fixed threshold are immediately deactivated.

19. A method for managing electric power consumption of a users systems according to
5 claim 5 characterized in that in line with determined information values on Available Power (PD), the users (UI) with a effective priority (PriorEff) below a threshold associated to available power (PD) information are immediately deactivated.
20. A method for managing electric power consumption of a users systems according to
10 claim 2, characterized in that the control system (SC) of each smart user (UI) is allowed to use Reduced Load strategies and/or Reduced Consumption strategies.
21. A method for managing electric power consumption of a users systems according to one of the previous claims, characterized in that each smart user (UI) takes dynamic priority values (PRD) differing from the values of each other smart user (UI) to hinder the set of users (UI) from entering oscillation situations.
- 15 22. A method for managing electric power consumption of a users systems according to one of the previous claims, characterized in that each smart user (UI) draws a power packet (ΔP) in a different instant to hinder the set of users from entering oscillation situations.
- 20 23. A method for managing electric power consumption of a users systems, where each user has an associated priority (PriorEff) for access to energy consumption, characterized in that said priority (PriorEff) is used to initialise a timer (TP) in a proportional mode to said priority (PriorEff) and let the user (UI), whose relevant timer (TP) will first terminate its own count, have access to energy consumption.
- 25 24. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that the Priority Timer (TP) is obtained through a counter employing a higher number of bits than the number of bits employed for defining the priority (PriorEff).
25. A method for managing electric power consumption of a users systems according to

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the previous claim, characterized in that it uses the most significant bits (P8 ... P1) of the Priority Timer (TP) for representing the priority (PriorEff) and the less significant bits (I3, I2, I1) for a second temporary scansion.

26. A method for managing electric power consumption of a users systems, where each
5 user (UI) is associated to a priority (PriorEff, PRD) for access to energy consumption, characterized in that each smart user (UI) is provided to autonomously define its own Dynamic Priority (PRD) as a function of the operating state of the user (UI) itself and environment information.
27. A method for managing electric power consumption of a users systems according to
10 the previous claim, characterized in that dynamic priority (PRD) is defined as a function of information, such as user service duration and/or program in course and/or a program step and/or remaining time to end the step and/or possible program reconfiguration to request less power and/or consumer's habits and/or timetable for service to end and/or electric low-rate timetables.
- 15 28. A method for managing electric power consumption of a users systems according to claim 26 or 27, characterized in that Dynamic Priority (PRD) is determined through elaboration circuits operating according to fuzzy logic principles.
- 20 29. A users' system comprising a set of users (U), which comprises in turn a set of smart users (UI), with control systems (SC), said set of users (U) being operatively connected to an energy supply network (RE) and comprising, moreover, energy measuring means (CE, NM) apt to transmit information on energy consumption (PD) to said control systems (SC), where said control means (SC) perform autonomously energy consumption control of the associated smart user (UI) based on the information on energy consumption (PD) transmitted by the energy measuring means (CE, NM),
25 characterized in that said control system (SC) comprises means (TB6, TB7, TB8) for calculating a priority value (PRD) in function of the state of the associated smart user (UI)
30. A users system according to claim 29, characterized in that the control system (SC)

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comprises time counting means (TP) for performing a count based on the priority value (PRD).

31. A users system according to the previous claim, characterized in that the control system (SC) comprises logic fuzzy elaboration circuits for determining the dynamic priority (PRD) value.

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32. A users system according to the previous claim 27, characterized in that said control system (SC) is associated to sound and/or visual displaying means to signal information on energy consumption (PD).

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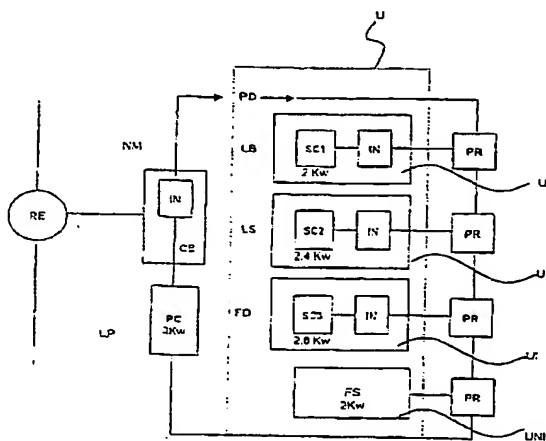
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[Continued on next page]

(54) Title: **METHOD FOR MANAGING ENERGY CONSUMPTION OF HOUSEHOLD APPLIANCES**



(57) Abstract: Method for managing power consumption of a users' system, said users' system comprising: a set of users (U), comprising in turn a set of smart users (UI) equipped with control systems (SC), said set of users (U) being operatively connected to a power supply network (RE); power measuring means (CE, NM), capable of transmitting information on power consumption (PD) to said control systems (SC); where the control systems (SC) perform power consumption control of the associated smart user (UI) on the basis of the information on power consumption (PD) transmitted by the power measuring means (CE, NM). According to the present invention, each control system (SC) performs power consumption control of the associated smart user (UI) on the basis of the information on power consumption (PD) and of the information on the state of the associated smart user (UI) obtained from the control system itself (SC), said information on power consumption (PD) and state information (PriorEff) of the smart user (UI) being processed for determining a priority (PriorEff), so as to establish a right for the associated smart user (UI) to the consumption of power packets (ΔP) available from the power supply network (RE).

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METHOD FOR MANAGING ENERGY CONSUMPTION OF HOUSEHOLD APPLIANCES

DESCRIPTION

5 The present invention relates to a method for managing power consumption of a users system, said users system comprising

- a set of users, comprising in turn a set of smart users equipped with control systems, said set of users being operatively connected to a power supply network;
 - power measuring means, capable of transmitting information on power consumption to
- 10 said control systems;

where the control systems perform power consumption control of the associated smart user on the basis of the information on power consumption transmitted by the power measuring means.

When simultaneous operation of a number of users in a given environment may require a

15 greater resource availability than actually available, an automatic organization would be appropriate to limit the number of active users at the same time and/or impose a temporary reduced operation to all or just a few of them. Such a requirement is particularly felt for electrically supplied household appliances where said resource is the electric power available by contract from the Electricity Board. The automatic organization has to choose

20 the users to be favoured from time to time based on fully accepted procedures (first come first served) or adopt any principles, which in a more or less complex manner will respect the priority levels assigned to the users during their performance.

Limiting consumption peaks is an appropriate measure resulting in significant savings ; in fact, power supply structures have to be oversized due to absorption peaks. For the person

25 using the appliance (hereinafter referred to as "consumer") such a restriction may entail a saving, should over-consumption be subject to an electricity rate increase, or improved global performances, should over-consumption cause a current cut-off.

Of course, whichever such an automatic organization may be, it is assumed that more or

less smart users exist, i.e. capable at least of sending and/or receiving signals and modifying their state according to the signals received. However, also the presence of dummy users has to be inevitably provided in general, i.e. without the interactive capacities of smart users.

5 Systems are known, for instance, whose organization is obtained through a duly programmed central unit informed about the required data, which co-ordinates the users either by giving or by denying them the consent for full power activation or even a partial load. Among these, the most evolved central units also know how to manage the priority requirements for the services assigned to the users.

10 Such a control principle is expressed for instance in the patents US 4.324.987, US 4.418.333, US 5.544.036, US 5.4365.510, US 5.625.236, US 5.598.349, US 5.543.667.

Centralized power management through a co-ordination central unit (or power manager) has anyway several drawbacks, in particular due to the fact that if a users configuration changes (either by elimination, replacement or addition), also the central unit has to be
15 reconfigured, as in the instance of the above patent US 5.436.510, where, additionally, a predetermined portion of the assigned power is always left available to not controllable or dummy users (such as irons, electric stoves, etc.), thus practically reducing constantly the power allowed for use.

Moreover, the global reliability level of such systems is at the most equal as for the central
20 unit; if the latter becomes faulty, the whole system operation is jeopardized; in some environments, in particular in a household environment, a reduced user reliability just for the sake of integrating it in a complex services system cannot be accepted.

A clear improvement has been achieved by the system described in the Italian patent IT. 01279545 filed in the same Applicant's name, where a central unit is indeed provided, but
25 having no co-ordination and control functions of the users, as it is restricted to supply essential information, i.e. maximum usable power, actual power used (measured in real time), likely electricity tariff at the moment if special timetable tariffs are provided, and so on. Said patent discloses smart users, intercommunicating mutual information on their own

requirements and priority levels; each smart user will take note of the requirements of the other users and either reduce or cancel its own absorption if sufficient power is not available and its own priority is not the highest among the ones mutually communicated, making way for the other ones. Of course, likely dummy users are unable to deal, i.e. they reserve highest priority to themselves, but will use power only while they are in operation, so that the system does not always need to reserve a power portion to them.

Such a power consumption organization represents a substantial progress, since the system regulates itself spontaneously, independently from any configuration change of the users set; in fact, the organization is not centralized, but it is the result of a "mediation" between smart users.

This notwithstanding, the procedure described above has some drawbacks due to the very high number of information to be communicated among the users and complex elaboration requested of each smart unit.

It is the object of the present invention to solve the above drawbacks and provide a method for managing power consumption of a users system, having a more efficient and improved performance.

In this frame, it is the main object of the present invention to provide a method for managing power consumption of a users system, which avoids exceeding a predetermined power threshold globally absorbed by said set of smart users, controlling their consumption on the basis of their own rules and internal information as well as on regular information supplied by a central unit.

A further object of the present invention is to provide a method for managing power consumption of a users system, which in case of faulty central unit or of one or more of said "smart" users will warrant no less operation reliability of the remaining users than obtainable if said central unit were missing.

A further object of the present invention is to provide a method for managing power consumption of a users system, which ensures a stable system, letting the users terminate their duties within reasonable times without jeopardizing their performance nor increasing

global consumption and moreover preventing the arising of oscillations.

In order to achieve such aims, it is the object of the present invention to provide a method for managing power consumption of a users system incorporating the features of the annexed claims.

5 Further objects, features and advantages of the present invention will become apparent from the following detailed description and annexed drawings, which are supplied by way of non limiting example, wherein:

- Fig. 1 shows schematically a household electric installation with a set of users according to the present invention;
- 10 - Fig. 2 shows a states diagram related to a first embodiment of the method for managing power consumption of a users system according to the present invention;
- Fig. 3 shows a states diagram related to a second embodiment of the method for managing power consumption of a users system according to the present invention;
- Fig. 4 shows a diagram representing absorbed power ranges related to the method for
15 managing power consumption of a users system according to the present invention;
- Fig. 5 shows the qualitative trend of a quantity employed in the method for managing power consumption of a users system according to the present invention;
- Fig. 6 shows a value assignment table of a second quantity employed in the method for managing power consumption of a users system according to the present invention;
- 20 - Fig. 7 shows a second table related to the quantity of figure 6;
- Fig. 8 shows a third table related to the quantity of figure 6;
- Fig. 9 shows a quantity trend of figure 6 as a function of time;
- Figs. 10-11-12 show three possible configurations of a device employed in connection with the power method for managing power consumption of a users system according to
25 the present invention.

Figure 1 shows a power distribution system in a household environment, where electric power is drawn from an external network RE through an electric power meter CE and restricted by a power limiter LP to the value provided in the electricity supply contract (3

kW in the above example).

Four current sockets indicated with PR supply an equal number of users U, i.e. a laundry wash-machine LB with 2 kW power, a dishwasher LS with 2.4 kW power, a baking oven FO with 2.8 kW power and an iron FS with 2 kW power. The electric meter CE, laundry
5 wash-machine LB, dishwasher LS and oven FO are all supplied from the electric network through a suitable electronic interface IN, which is provided to let information transmission and reception through the electric network utilizing carrier modulation waves. On the other hand, any known communication means can be used for the achievement of the present invention.

10 The electric meter CE is capable to send at regular time intervals the value of an Available Power PD to the users, e.g. every minute, and/or in line with a relevant change of power absorption. In the following, such a generic information means obtained according to the known state of the art and identifiable with its associated electric counter CE, whose description is contained in the above patent IT. 01279545, will be called Measuring Node
15 NM.

Both the laundry wash-machine LB, dishwasher LS and oven FO are equipped with corresponding control systems called SC1, SC2 and SC3, respectively, in communication with the electronic interfaces IN. According to the present invention, such control systems, generally called in the following SC, are able to manage in a completely autonomous way
20 power consumptions of the user they are associated with. On the contrary, according to the control systems described in the patent IT. 01279545, users are able to exchange information mutually useful, in a co-operation-like manner, such as water hardness, humidity and room temperature.

From now on, the expression smart user UI will indicate indifferently all users U capable
25 of performing the functions provided in the present invention, i.e. equipped with the Control System SC, whereas the other users are called dummy users UNI.

Optimal consumption distribution is obtained instructing the Control System SC of each user UI to obtain the power required according to a coherent behaviour with its momentary

need to perform or not its assigned service; in other words, the behaviour of each user UI is exclusively conditioned by the priority level, instant by instant, of the performance of its service and actual availability of the required power.

This is provided causing the Control System SC of every smart user UI to take decisions
5 about the behaviour of the smart user UI itself, simply basing the decision on the Available Power PD value at the moment and on the value of a parameter called Effective Priority PriorEff, calculated by the Control System SC itself.

According to the present invention, in most Control System SC states the Effective Priority value PriorEff is equal to a quantity called Dynamic Priority PRD. Also said Dynamic
10 Priority PRD is calculated by each Control System SC on the basis of specific predefined instructions for each smart user UI, on internal information related to the state of the smart user UI itself (such as program steps, monitored temperatures, etc.), and finally on external information supplied by the Measuring Node NM.

Summarizing, the Control System SC state depends on Available Power PD communicated
15 by the Measuring Node NM and Effective Priority PriorEff value calculated by the Control System SC itself; Effective Priority PriorEff in turn takes values, which may also depend but not necessarily on the information received from the Measuring Node NM.

Then, the Measuring Node NM, as it will become apparent later, does not absolutely impart any command to smart users UI, but it will restricts itself to supply the same
20 information to all of them conditioning their behaviour indirectly only, since smart users UI themselves will take received information into account for modifying their state, if required. Moreover, the Control System SC state of each user UI is not conditioned by a transaction with other users UI, as occurring on the contrary in the system described in the patent IT. 01279545.

25 According to the present invention, in fact, each smart user UI acts quite autonomously, regardless of the requirements of other smart users UI or dummy users UNI.

The global behaviour of smart users UI and dummy users UNI is very similar to that of a population of individuals or cellular automata where a substantially stable regular total

result may not be the result of a predetermined design but rather of uncoordinated individual actions that share only common behaviour rules.

According to a first embodiment of the present invention, the Control System SC of each smart user UI uses a first principle to take the required power for operation, called

5 “Competition for Increment”.

According to a second embodiment of the present invention, the Control System SC of each smart user UI uses a second principle to take the required power for operation, called “Competition for Decrement”.

According to the present invention, the Measuring Node NM is provided for constantly
10 measuring an Absorbed Power PA, i.e. the electric power actually absorbed by the users U and, moreover - knowing the subscribed power supply PC, i.e. the maximum electric power usable according to the electric supply contract - transmitting information to the smart users UI on Available Power PD at sufficiently closed time intervals.

Figure 5 shows the information trend on Available Power PD as a function of time t. Since
15 the magneto-thermal switches allow the contract supply power PC to be exceeded to a certain extent before power is cut off, such a contract supply value is not exceeded immediately but with a delay, which will be the higher the less the absorption excess; then not necessarily the Measuring Node NM will send the negative Available Power PD message as soon as Absorbed Power PA exceeds the contract supply power PC. Therefore,
20 Available Power PD value may be a signal reprocessed by the Measuring Node and a function of an over-consumption PC-PA and duration of said overconsumption, and finally of the tolerances established by the Electricity Board for the magneto-thermal switch to operate.

Figure 5 shows in fact an example with a constant negative over-consumption PC-PA,
25 while Available Power PD, as function $f(PC, PA, t)$, will decrement in time when the over-consumption condition goes on until a negative value is reached,.

According to the present invention, when this situation occurs and the measuring node NM sends a negative Available Power PD message, active smart users UI receive said

information of negative Available Power PD and perform a competition process between themselves. At the end of the competition process, some smart users UI, generally but not necessarily those with the highest Dynamic Priority PRD value, take all or a major part of the power they require, whereas other users will only take a minimum quantity as
5 necessary for operation, and other users have not yet enough power to operate and go to a QUIESCENT State letting the first ones terminate their program without any interferences.

With regard to the above minimum power quantity necessary for operation, it will be appreciated how according to the teachings of the present invention it is eventually possible to get advantage from the fact that some users may decide for either Reduced
10 Consumption or Reduced Load operating strategies.

A Reduced Consumption strategy provides the same power absorption of the user as during normal operation but for a shorter time, thus reducing consumption. For instance, a washing machine LS can wash at a slightly lower temperature than usually required, because extension of mechanical wash times warrants the same performances; therefore, if
15 the machine is informed through a poor Available Power PD information that other users request power, it may choose alternative wash strategies to the basic one, deciding for lower wash temperatures and longer wash times, which will use power for less time and allow earlier activation of other users.

On the contrary, a Reduced Load strategy provides substantially the same energy
20 consumption of the user as during normal operation, but using less power and consequently a longer time. For instance, an electric buffer water-heater or electric stove equipped with two or more electric heaters may have a slower heating process choking the load, thus using less power for a longer time, so as to allow operation in parallel of other users.

Summarizing, some smart users UI may operate at different consumption levels or with a
25 Reduced Load using either the same power for a longer or shorter time or one or more power "packets" ΔP ; the time during which power is requested may be shortened letting other users switch on earlier, or the power used may be reduced to let other users switch in simultaneously. Of course, such strategies entail some sacrifices in terms of quality or

energetic cost of the service, but will improve the coexistence of several users.

It will become apparent, in the following, how according to the present invention, it is extremely simple to utilize such strategies for reducing conflicts between users.

The principle for establishing the winning users UI in a competition process, which have
5 the right to access to power consumption during competition is obtained by the result of actions conditioned by Effective Priority PriorEff assigned to each smart user UI. Effective Priority PriorEff of a user UI is variable in time and reflects the task difficulty of a user UI in its evaluation moment, which difficulty is represented in turn by Dynamic Priority PRD. Dynamic Priority PRD is an integer value comprised between 0 as Null Priority PRN value
10 and $2^n - 1$, Maximum Priority PRM, where n is the number of bits used to represent said Dynamic Priority PRD; thus, Dynamic Priority PRD expresses the urgency for each user to perform a determined service.

Principle of Competition for Increment

The operating procedure according to Competition for Increment is now illustrated with
15 reference to figure 2.

With reference to figure 5, Available Power PD will mean in the following the function f (PC, PA, t); therefore, when Available Power PD is said to be either negative or positive to indicate an over-consumption or not, this means that the corresponding function f (PC, PA, t) will take either negative or positive values.

20 The arrows marked T.1 to T.8 indicate possible State Transitions, said States being identified S.1 to S.4. The relevant conditions for Transitions are indicated in bold letters in line with each transition; underneath them are the operations executed by the Control System SC. In said figure 2, as in the subsequent figure 3, the quantities indicated with the symbol "[i]" represent specific values related to the user "i"; whereas the remaining
25 quantities may have a common value for all control systems SC. In particular, the following quantities are shown, whose meaning will be explained later:

- Actually absorbed power Pot[i], i.e. the power absorbed by the smart user UI, evaluated by the relevant Control System SC through known means;

- Power packet $\Delta P[i]$, which is a discrete from time-to-time variable power quantity, to which the winning smart user UI in Competition for Increment can have access;
- Minimum power $P_{Min}[i]$, which is the minimum power a smart user UI can use to perform a service or a function;
- 5 - Maximum power $P_{Max}[i]$, which is the maximum power required by the user UI to perform the same service or function;
- User's Effective Priority $PriorEff[i]$;
- Available power PD as defined above;
- Power thresholds K_0 and K_1 ;
- 10 - Priority thresholds $PrioMin$ and $PrioMax$.

In all states taken by the Control System SC, Effective Priority $PriorEff$ is equal to Dynamic Priority PRD, save for QUIESCENT State S.3 and WAIT state S.4.

- Let us assume to have a generic smart user UI normally working in a generic instant. When said smart user UI switches on, its Control System SC is in ON State S.1 and the operation
- 15 strategy chosen is the standard one, i.e. requesting all required power and energy. Control System SC is informed at time intervals on available power PD; during such a State S.1 it may receive along with the other users UI an overload signal, i.e. Available Power $PD < 0$.

Transition T.1 from ON State S.1 to COMPETITION FOR INCREMENT State S.2.

- Upon receiving the overload signal, Control System SC goes to the COMPETITION FOR
- 20 INCREMENT State S.2. Prior to Transition T.1 it will deactivate the loads of its smart user UI, save for a minimum absorption required for a "stand-by" state (controls, warning lights, etc.), set its Effective Priority $PriorEff$ on the value of its current Dynamic Priority PRD, set a timer called Priority Timer TP on the value of Effective Priority $PriorEff$ and process a Reduced Consumption operating strategy, if provided for that user type. Also the
- 25 other smart users UI, having received the same Available Power PD value and being equipped with a similar Control System SC will perform the same transition T.1 and substantially reach COMPETITION FOR INCREMENT State S.2 in the same instant. Of course, at the same time Available Power PD has probably become a positive power as all

users U have been deactivated, except for the dummy ones UNI.

Once COMPETITION FOR INCREMENT State S.2 is reached, Control System SC of each smart user UI will increment its own Priority Timer TP, being the increment speed associated with each user UI properly determined based on experience data. Four possible
5 transitions are available to exit this state.

Transition T.2 from COMPETITION FOR INCREMENT State S.2 to COMPETITION FOR INCREMENT State S.2

The Priority Timer TP reaches count end, i.e. the Maximum Priority PrioMax value equal to 2^{n-1} , identical for all smart users UI, and verifies that Available Power PD current value
10 with a sufficient pre-set safety margin defined by the power threshold K0 is higher than a first value, called power packet $\Delta P[i] = P_{Min}[i]$, which allows operation at a first Reduced Consumption level, draws such a power amount or packet $\Delta P[i]$, sets the Priority Timer TP again on its Dynamic Priority PRD current value and goes back to COMPETITION FOR INCREMENT State S.2. This Transition T.2 may be executed several times if various
15 Reduced Consumption operating strategies are available for said user, each one characterized by power packets $\Delta P[i]$ generally differing from each other.

If the smart user UI has undergone no interferences, at the end of several Transitions T.2 it will have been assigned the whole maximum power PotMax provided by its Control System SC for a full-load operation strategy, though operating according to a Reduced
20 Consumption strategy, if provided.

Transition T.3 from COMPETITION FOR INCREMENT State S.2 to QUIESCENT State S.3.

The Priority Timer TP reaches its count end as in the previous instance and ascertains that the power actually absorbed Pot[i] is lower than the minimum power PMin[i], which
25 allows performance of any Reduced Consumption operating strategy, i.e. the power currently absorbed Pot[i] is the lowest one required by the user for its stand-by condition (warning lights, Control System SC, etc.). As it is apparent, the user UI was not in time, nor will now be able to take power packets $\Delta P[i]$, which have gone to other users with a

higher Dynamic Priority PRD. In such a situation, Control System SC goes to QUIESCENT State S.3: its Effective Priority PriorEff is reset and then slowly incremented; as long as the smart user UI has not reached a minimum value it cannot activate any of its loads. This will prevent oscillations and warrant stability. In fact, if after
5 a competition the users UI that were unable to take power packs $\Delta P[i]$ are allowed to be reactivated as soon as there is Available Power PD, they may insert themselves for instance during a thermalization step of the oven FO, cause a new competition and then a cycle trend, which will not let any user operate efficiently. On the contrary, since in order to warrant efficiency the user that started a function must be able to end it in a short time,
10 so it should not be disturbed.

Effective Priority PriorOff value that was reset in Transition T.3 will be incremented to exceed priority threshold PriorMin. Such a value, based on experience, must be sufficiently high to avoid any interferences to other users with priority at the moment; before exceeding such a value, as said, the user is not allowed to attempt procuring any power not
15 even if Available Power PD is high enough.

Transition T.4 from COMPETITION FOR INCREMENT State S.2 to COMPETITION FOR INCREMENT State S.2.

Should Available Power become negative at any time as in the condition originating Transition T.1, the loads are deactivated refraining from drawing power packets $\Delta P[i]$
20 possibly won during one or more Transitions T.2, the Priority Timer TP is set again on the Effective Priority PriorEff value, and then back again to COMPETITION FOR INCREMENT State S.2.

Transition T.5 from COMPETITION FOR INCREMENT State S.2 to ON State S.1.

Should Control System ascertain at any time, but certainly at the end of at least a Priority
25 Timer TP count, that an actually absorbed power Pot[i] has been assigned, equal to PotMax[i] required for full-load operation, then Control System SC can go back without delay to the ON State S.1.

Transition T.6 from QUIESCENT State S.3 to WAIT State S.4.

This occurs when Effective Priority PriorEff has exceeded the Priority Threshold PrioMin and allows transition to the WAIT State S.4, wherefrom it is possible to return to competition. This occurs in two ways, as follows.

Transition T.7 from WAIT State S.4 to COMPETITION FOR INCREMENT State S.2.

- 5 This occurs if Available Power PD value exceed the value PMin[i], plus a safety margin according to the power threshold K1, which can perform a Reduced Load operating strategy. Effective Priority PriorEff is set equal to Dynamic Priority PRD, the user started at Reduced Load (Pot[i] = PMin[i]) and the Priority Timer PT set.

Transition T.8 from WAIT State to the ON State S.1.

- 10 Provocatively, if Effective Priority PriorEff exceeds the Maximum Priority PrioMax value equal to 2^{n-1} , it goes to maximum load, i.e. to the ON State S.1; this will surely cause other state transitions of the other active smart users UI towards COMPETITION FOR INCREMENT S.2 wherefrom, this time, the smart user UI in question will have more chances to be the winner, since meanwhile its Dynamic Priority PRD value
15 has certainly increased.

- It will be remembered how in the first transition T.1 the user UI had reached a Reduced Load operating strategy wherefrom no change of the Control System SC has caused its exit; in fact, if this choice is made it is advisable to maintain it until service end (e.g. wash program) when it will finally be deactivated; anyway, nothing hinders to provide that
20 before returning to the ON State S.1 the Control System SC will take the user UI back to a standard consumption strategy.

Principle of Competition for Decrement

With reference to figure 3 an embodiment of the present invention is now described, which provides a behaviour diagram called "Competition for Decrement".

- 25 The states provided for the Control System SC are substantially identical to those of the simple "Competition for Increment", save adding a further "Competition for Decrement" state S.6, wherein the users with a lower Dynamic Priority PRD are caused to leave the power conquest competition.

As seen above, "Competition for Increment" is a power assignment race of users UI; when Available Power PD becomes negative, all users UI will deactivate their loads and gradually reactivate until the whole power is allocated in an optimal way. The advantage of this method consists in simultaneous deactivation of all users UI, so that the magneto-thermal switch will not operate. However, a drawback is that during a lapse of time lasting 30 to 60 seconds also operation of higher priority users will be interrupted.

The problem can be solved according to the principle "Competition for Decrement", i.e. the users are not immediately deactivated, the Priority Timer TP counts backward and upon resetting the user releases a power packet $\Delta P[i]$. The user UI goes over to a QUIESCENT State S.8 if deprived of the minimum power PMin required, it returns to ON state S.5 if Available Power PD is positive and had not to release a power packet ΔP , and it remains in a competition state as long as one of these conditions will not occur. The diagram is modified as follows with respect to figure 2:

A COMPETITION FOR INCREMENT State S.7 is always provided, whose output transitions are similar to the ones represented in figure 2, but not detailed here for simplicity's sake. State transitions of COMPETITION FOR INCREMENT S.7 and COMPETITION FOR DECREMENT S.6 have been submitted to a "hysteresis" to prevent oscillations between both states. Exiting a Wait State is similar to "Competition for Increment", i.e. energy packets ΔP will be assigned to the user UI as soon as they become available.

Control System SC states are as follows:

S.5: ON STATE

Action: operation according to the current program

S.6: COMPETITION FOR DECREMENT STATE

Action: decrementing Timer Priority TP, operation level restricted to the level permitted by active loads

S.7: COMPETITION FOR INCREMENT STATE

Action: incrementing Timer Priority TP, operation level limited to the level permitted

by active loads

S.8: QUIESCENT STATE

Action: Incrementing Effective Priority PriorEff

S.9: WAIT STATE

5 Action: Incrementing Effective Priority PriorEff.

The above state transitions, their conditions for occurring and implied actions are listed as follows: many transitions are conditioned whether Available Power PD exceeds or not power threshold values K2, K3 and K4, which delimit the power using ranges as shown in the diagram of figure 4.

10 In fact, it is possible to establish a tolerance threshold for Available Power PD, namely threshold K2. This threshold K2 is higher than threshold K3; the latter is a minimum, void or negative threshold as represented in figure 4, below which the users system U will reach an overload. When power absorption is such to let Available Power PD go below the threshold K2, smart users UI with a low priority will immediately deactivate some loads to
15 bring consumption level back within safety limits; such an event is better than immediate deactivation of all loads, the latter being more appropriate for an emergency situation.

Moreover, preventive deactivation of some loads when $PD > K2$ will reduce likely emergency operations.

If the consumption level decreases too much ($PD > K4$), the users go over to Competition
20 for Increment and have the opportunity of winning power packets again. Therefore, consumption is maintained at an optimal level, such as $K2 < PD < K4$.

T.9: transition from ON State S.1 to COMPETITION FOR DECREMENT State S.6

Condition: the Measuring Node NM sends a message of Available Power PD
25 $PD < K2$ (poor Available Power PD or a users system U approaching over-consumption).

Actions: setting Priority Timer TP on Dynamic Priority PRD current value, processing a Reduced Consumption strategy, if feasible.

T.10: transition from ON State S.5 to COMPETITION FOR INCREMENT State S.7

Condition: the Measuring Node NM sends a message of Available Power PD < K3 with $K3 < K2$ (negative Available Power PD or system in over-consumption).

5 Actions: loads deactivation, setting Priority Timer TP on Dynamic Priority PRD current value, processing a Reduced Consumption strategy, if feasible. As it can be seen, since $K3 < K2$, this condition is more critical with respect to the event determining the transition T.9 and will request immediate deactivation of all loads.

T.11: transition from COMPETITION FOR DECREMENT State S.6 to ON State S.5.

10 Condition: the Measuring Node NM sends a message of Available Power PD > K2 (Available Power PD exceeding the safety threshold) while the user UI is still using all maximum power PotMax provided by its program).

Actions: not provided.

T.12: transition from COMPETITION FOR DECREMENT State S.6 to COMPETITION FOR INCREMENT State S.7.

15 Condition: the Measuring Node NM sends a message of Available Power PD > K4 (enough Available Power PD for reactivation of some loads without the risk of approaching over-consumption).

Actions: not provided.

Transition T.12 does not require Priority Timer TP to be reset.

20 T.13: transition from COMPETITION FOR DECREMENT State S.6 to COMPETITION FOR INCREMENT State S.7.

Condition: the Measuring Node NM sends a message of Available Power PD < K32 (insufficient Available Power PD or system in over-consumption, PD < 0)

Actions: loads deactivation, setting Priority Timer TP on Dynamic Priority PRD current value;

25 As it can be seen from the State S.6 it goes over to the State S.7 due to both Available Power PD and over-consumption: in one event the users will maintain active loads and be able to get more power, in the other everything will be deactivated.

T.14: transition from COMPETITION FOR DECREMENT State S.6 to COMPETITION FOR DECREMENT State S.6

Condition: Priority Timer TP at count end and $PD < K2$ (system approaching over-consumption), the user UI releases a power packet ΔP . According to a possible embodiment, the user UI will deactivate one load only in the event of the power parcel ΔP so released being a significant fraction of the contract supply power PC. This solution helps protecting lower priority and low consuming smart users UI, which do not lead to any significant contribution when deactivating themselves. Of course, in the Competition for Increment State S.7 they are safeguarded, since though reaching count end later, they can also benefit of lower power levels left unused by other users requiring for instance 1 or 2 kW.

Actions: The user UI does not change its state, it releases the power packet $\Delta P[i]$ and sets the Priority Timer TP on Dynamic Priority PRD current value. An embodiment related to utilization of the Priority Timer TP, shown in the following, provides both events in separate moments, i.e. power packet $\Delta P[i]$ release and Priority Timer TP setting, though they should be logically considered part of just one transition.

T.15: transition from COMPETITION FOR DECREMENT State S.6 to QUIESCENT State S.8.

Condition: Priority Timer TP at count end and $Pot[i] < PMin[i] + k2$: the user UI has lost competition.

Actions: resetting Effective Priority PriorEff value ($PriorEff[i] = 0$).

T.16: transition from COMPETITION FOR INCREMENT State S.7 to COMPETITION FOR DECREMENT State S.6

Condition: The Measuring Node NM sends a $PD < K2$ message (either poor Available Power PD or system approaching over-consumption); $K2 < K4$ is assumed to avoid oscillations between States S.6 and S.7.

Actions: none

T.17: Transition from QUIESCENT State S.8 to WAIT State S.9

Condition: $\text{PriorEff}[i] > \text{PrioMin}$

Actions: none

T.18: Transition from WAIT State S.9 to COMPETITION FOR INCREMENT State S.7

5 Condition: $\text{PD} > \text{PMin}[i] + K2$ and $\text{PD} > K4$

Actions: Setting Priority Timer TP, $\text{Pot}[i] = \text{PMin}[i]$.

As it can be seen, $\text{PD} > K4$ condition ensures that no users will go over to Competition for Increment as long as other users are still in Competition for Decrement.

10 T.19: Transition from WAIT State S.9 to ON State S.5

Condition: $\text{PriorEff}[i] > \text{PrioMax}$

Actions: activation of all loads provided.

The following transitions are similar to the transitions already described in figure 2 for analogous states; both the conditions and actions they refer to are omitted in the Diagram of figure 3 for simplicity's sake.

15 T.20: Transition from COMPETITION FOR INCREMENT State S.7 to ON State S.5

Condition: the Measuring Node NM sends a $\text{PD} > K2$ message (Available Power PD exceeding the safety threshold) and the user is already using the whole power provided by its program.

20 Actions: not provided.

T.21: Transition from COMPETITION FOR INCREMENT State S.7 to COMPETITION FOR INCREMENT State S.7

Condition: the Measuring Node NM sends a $\text{PD} > K3$ message (negative Available Power PD or system in over-consumption)

25 Actions: loads deactivation, Priority Timer TP setting on Dynamic Priority PRD current value.

T.22: Transition from COMPETITION FOR INCREMENT State S.7 to COMPETITION FOR INCREMENT State S.7

Condition: Timer at count end and $PD > \Delta P[i] + K2$

Actions: $Pot[i] = Pot[i] + \Delta P[i]$

T.23: Transition from COMPETITION FOR DECREMENT State S.7 to QUIESCENT State S.8.

5 Condition: Timer at count end and $Pot[i] < PMin[i] + K2$: the user has lost competition.

Actions: Dynamic Priority PRD value is reset.

According to an embodiment, the Control System SC in the Competition for Decrement principle may also operate without transitions T.10 and T.13; however, the reaction to an
10 over-consumption situation is slower with the risk that the magneto-thermal switch could intervene.

According to an embodiment of the present invention, threshold power values K0, K1, K2, K3 and K4 may be modified at any time should it be necessary to correct the behaviour of smart users UI, so as to let them be transmitted by the Measuring Node NM to all Control
15 Systems SC; thus, modification of the global behaviour of smart users UI will be quite simple.

As already noticed with reference to figure 5, another embodiment of the present invention may take into account that the magneto-thermal switch does not immediately trip in the event of a power over-consumption, but it undergoes a delay, which is much higher the
20 less over-consumption will be. Transitions depending on evaluations of Available Power PD, such as T.9, T.10, T.11, T.12, T.13, T.16 of figure 3, may not be immediate, but occur with a delay, which is much higher the less the value of limit excess will be. This can be obtained having the Available Power PD value transmitted by the Measuring Node NM not simply equal to the difference $PC - PA$, but a more complex function f always of PC and
25 PA and of over-consumption duration t as well. The function f can be very well calculated in the fuzzy mode or based on written values of a Table. A system responding to the real over-consumption value and its duration will utilize the low-pass filter feature of the magneto-thermal switch, making the system more stable and free from impulsive

absorption loads.

From the above description it is possible to change the global behaviour of the users set U to render it more or less alarmist simply amending the principles used by the Measuring Node NM to calculate the transmitted available Power PD value. This may occur at any future time without causing an instructions change to the Control Systems SC of users UI.

Figures 2 and 3 show Control Systems SC behaviour in detail to prove feasibility of the teachings contained herein by way of example, although more complex amendments to the basic diagrams called "Competition for Increment" and "Competition for Decrement" are possible.

- By way of example, a third embodiment is possible, where upon exceeding the contact supply power PC only the users UI with a priority below a threshold will be deactivated. If following this deactivation Absorbed Power PA is lower than the contract supply power PC, then smart users UI will remain in ON State, whereas the deactivated users go over to the COMPETITION FOR INCREMENT State. If, on the contrary, Absorbed Power PA is still higher than the limit, active users UI go over to the COMPETITION FOR DECREMENT State and the deactivated users to QUIESCENT State. A balance can be reached faster with this method; however, since a preliminary priority based exclusion takes place, it may happen that a low priority and low consuming smart user UI is deactivated uselessly, i.e. without releasing enough energy to any other user.
- Finally, a fourth embodiment is obtained if the cut-off priority threshold depends on an over-consumption value.

Summarizing, four procedures have been defined according to which competition may occur following Available Power PD, as listed below:

1. Competition for Increment

- As described in figure 2, all loads are deactivated when a timer inside each user expires, each user wins a power packet and the process ends as soon as there is no more Available Power PD.

2. Competition for Increment or Decrement

As described in figures 3 and 4, users UI will all enter competition for Increment or Decrement based on the Absorbed Power PA value exceeding the contract supply power limit.

3. All users UI whose priority is below a fixed threshold are immediately deactivated

5 a) If, after deactivation, instantaneous Absorbed Power PA is lower than the contract supply power PC, then the still active users UI are in ON State and the others in the Competition for Increment State.

b) If, after deactivation, instantaneous Absorbed Power PA is higher than the contract supply power PC, then the still active users UI are in Competition for
10 Decrement State and the others in QUIESCENT State.

4. All users UI whose priority is below a threshold related to an over-consumption value are immediately deactivated

a) If, after deactivation, instantaneous Absorbed Power PA is lower than the contract supply power PC, then the still active users UI are in ON State and the
15 others in Competition for Increment State.

b) If, after deactivation, instantaneous Absorbed Power PA is lower than the contract supply power PC, then the still active users UI are in Competition for
Decrement State and the others in QUIESCENT State.

Solutions 3) and 4), though having a higher complexity, offer the advantage of warranting
20 balance achievement within a shorter time. In fact, some users UI are instantaneously deactivated, some remain active and only the power for intermediate priority users UI will have to be allocated. However, adopting this procedure one of the advantages offered by Competition for Increment will be lost, i.e. optimal power allocation. In Competition for Increment, in fact, a low priority and low consuming user UI has the possibility of going
25 back to operation if the power used by it is too low for activating any other user UI. Moreover, in order to reach allocation of Available Power PD, these solutions have to go through a competition stage. Lacking a central controller, the procedure chosen for optimal allocation is to induce each user UI to proceed iteratively in one direction until the

engagement for the contract supply power PC has been fulfilled, without requiring a priority threshold, which is neither a fixed one nor over-consumption based to decide in advance which user should be deactivated or not.

The rules determining state transitions hinder a possible coexistence of users in Competition for increment State with others in Competition for Decrement State. This operation would not be a reasonable one as it could generate users subsets reaching the balance in an autonomous, not mutually coherent, manner; priority constraints would be respected only within such subsets, but not in absolute. These two states cannot coexist in a system, since Competition for Increment and Competition for Decrement state transitions are activated by equal conditions for all users; as a result, if a user goes over to one of the two states also all the other ones will go over, unless they are in a Quiescent or Wait state. It should be noticed that as long as there are users in the Competition for Decrement State, there will be no verification of the condition causing users to enter a Competition for Increment.

15 **Dynamic Priority PRD**

Elaboration methods of Dynamic Priority PRD values are now described, which are referred to by each Control System SC in the Competition States.

All useful information for determining current dynamic priority PRD of each smart user UI are directly processed by the smart user UI itself. Several variables are combined in one information alone, i.e. dynamic priority PRD, thus solving complexity at local level, without overloading the system and without requiring a central direction. Dynamic Priority PRD, on its own, contains high level information, i.e. to what extent more or less power should be warranted to each user.

In order to represent "rich" information and prevent possible conflicts between the users, Dynamic Priority PRD is a continuous "variable" or more exactly it can take any integer value from 0 to 255 or in general 0 to 2^n , if n is the number of available bits for storing and communicating such information. Moreover, Dynamic Priority PRD is exactly "dynamic", i.e. it is calculated in real time by a fuzzy system contained in Control System SC as a

function of parameters, such as :

- Duration of user service
- Program in course
- Programme step
- 5 • Remaining time to end the step
- Possible program reconfiguration to request less power
- Consumer's habits
- Requested time to end the service
- Electric current special time rates

- 10 The Dynamic Priority PRD value is not preferably deducted according to a mathematic calculation, but is rather defined by a process expert of each single user; therefore, Dynamic Priority PRD is calculated by a fuzzy system representing the expert's knowledge. This method allows utilization of the fuzzy inferential motor already available in the microprocessor of the Control System SC of the user UI, thus optimising both the
- 15 memory occupancy and performance.

Figures 6, 7, 8 and 9 show some orientative non limiting examples of the principles for assigning the values to Dynamic Priority PRD using fuzzy systems. In particular, figure 6 shows a Table TB6 reporting an example of values assignment to Dynamic Priority PRD, which favours some users UI to the detriment of other users.

- 20 Figure 8 shows a Table TB8 reporting an example of values assignment to Dynamic Priority PRD, which avoids interrupting a delicate wash process, such as a woollens wash cycle; in figure 7 a table TB7 shows two examples of logical proportions for a wash process where the Dynamic Priority PRD value depends on both the type of fabric and heating step progress. Figure 9 shows Dynamic Priority PRD trend in time for a laundry
- 25 wash-machine during a heating step; as it can be seen, Dynamic Priority PRD provides a tolerance for load deactivation at the beginning and at the end of the heating step, but not in correspondence with the main step where deactivation may lead to a dispersion of the energy just used for the heating step.

Dynamic Priority PRD calculated as above is used through Effective Priority PriorEff any time a Priority Timer TP count is performed.

In the QUIESCENT and WAIT states, on the contrary, Effective Priority PriorEff is a fictitious value apart from the above parameters and is incremented in time with principles based on experience and not necessarily identical for each type of smart user UI. The simplest solution would be to provide a fixed increment for each user; however, a better solution is to calculate the increment as a function of the Dynamic Priority PRD that a smart user UI would have if not in ON State. For instance, the increment may equal a fraction of the Dynamic Priority PRD.

10 **Priority Timer TP**

Occasionally, two smart users UI may have an equal Dynamic Priority PRD; in this event it should be avoided to have them attempting to take a power packet simultaneously, as this would cause a new overload and lead the system to a oscillations state. It must be stated that in order to represent Dynamic Priority PRD $256 = 2^8$ values are enough, but not strictly required. The event where 8 bits are used is explained in the following non limiting example, but the method shown can be used in general for a lower number of bits.

A first method to solve the conflict between two users UI with equal Dynamic Priority PRD is to hinder smart users PD from having an equal priority PRD, limiting the values between the various users, i.e. if smart users are m , with m being an integer, the i -th user UI can only take integer values as Dynamic Priority PRD values $(i - 1) + m \cdot k$, where k is an integer comprised between 0 and the ratio integer part $(2^n - 1)/m$ reduced by one unit, i.e. maximum $k = \text{INT}[(2^n - 1)/m] - 1$, where n is the number of bits.

For instance, if $n = 8$ and users UI are $m = 7$, the first user UI can take the following 36 values of Dynamic Priority PRD, i.e. 0, 7, 14, etc. up to 245; the second user will take other 36 values, i.e. 1, 8, 15, etc., up to 246, and so on.

If the set of users UI is a large one and consequently also m value is high, the drawback is that there will be a strongly reduced possibility of expressing different Dynamic Priority PRD values, e.g. for 10 smart users UI they will be reduced to 25.

A second method for solving the conflict between two users UI with equal Dynamic Priority PRD is to share the time interval available for users UI to take energy packets in m intervals, each one reserved for a user UI.

For both methods each user UI will be assigned a progressive number I; this can be done manually during installation, but it will be easier automatically, i.e. during a first installation each new user UI may communicate its own presence to the Measuring Node NM, which reacts assigning the newcomer a progressive order number i, which is equal to the number of smart users UI already installed plus one.

With reference to figures 10, 11 and 12, it will be seen how these two methods can be optimised using them combined together to develop a third method, where the resources of the microprocessor contained in the Control System SC are utilized without limiting the 256 priority values and without complications for the control program.

While Dynamic Priority PRD like Effective Priority PriorEff is represented with 8 bits, the Priority Timer TP is a 16-bit counter, so that the 8 less significant bits can be used to differentiate each user UI through its address, which is unique and assigned during installation.

More in detail, as shown in figure 10, when competition starts the 8 most significant bits P8, P7 ... P1 of the Priority Timer TP ("priority bits" in the following) are initialised at Effective Priority PriorEff current value, so that the Priority Timer TP value will substantially depend on Effective Priority PriorEff. The 8 less significant bits ("address bits" in the following) are set to zero, as cab be observed in figure 10. Let us assume in an orientative non limiting way that the effective address is expressed by 3 bits alone: I3 I2 I1 (it will be clear in the following which values are taken by the remaining "address bits"). This first setting of the Priority Timer TP occurs simultaneously for all the users deriving from a low Available Power PD situation.

During the Priority Timer TP count, the 8 address bits will scan all values from 0000.0000 to 1111.1111 for each increment of the 8 priority bits; since they all started simultaneously from the same value (in the specific instance 0000.0000), they always maintain the same

value during counting. Therefore, the instants in which the 8 address bits take the configuration I3 I2 I1 1.1111, each one with its own address, they will always be different for all users. Assignment of a power packet occurs when the 8 most significant bits are at 1 and the 8 less significant bits in the configuration I3 I2 I1 1.1111 (see figure 11), i.e. at
5 different times for each user UI.

When a Priority Timer TP reaches configuration 1111.1111.1111.1111, it is reset to the new value P8', P7', ... P1' taken by Effective Priority PriorEff in the meantime, whereas the address bits are reset as shown in figure 12. Simultaneously, also the 8 address bits of the other Priority Timers TP will be at 1111.1111 and obviously reset in the subsequent
10 instant. Therefore, the address bits of all Priority Timers TP always maintain the same value also after resetting.

The procedure described above is orientative and not limiting, i.e. the basic idea can be executed using different values for setting and final address bits configuration. It is essential to have the 8 most significant bits express Effective Priority PriorEff and the 8
15 less significant bits remain synchronized to each other so that the instant when they take a typical configuration this is necessarily different from the others and can be used as an instant for assigning a power packet, i.e. a second timed scansion. It should be noticed that the instant when the Priority Timer TP is set constraint to synchronization, this is necessarily distinct from the instant when a power packet is assigned, which is different for
20 each user UI as anticipated in transition T.14.

Obviously, the 16-bit instance is generally valid for any number of bits, provided it is capable of representing both a sufficient number of priority values and a sufficient number of user addresses.

A fourth procedure to hinder the system from oscillations consists in avoiding that two or
25 more users UI may have the same Dynamic Priority PRD value for an undefined number of subsequent competition States; this may happen in different ways, each one of them not excluding the other.

First of all the highest value achievable by Dynamic Priority PRD can be limited for those

users whose service is surely a minor one in certain hours, so as to favour e.g. an electric oven with respect to any other user.

According to a more general solution, Dynamic Priority PRD curves may all have a different slope as a function of time, as the ones shown in figure 9 associated with each

5 user UI, at least for those activity steps of the smart users UI requiring a relevant power absorption, where “considerable absorptions” mean those values determined by the experience. Thus, if for instance in a determined instant two “considerable absorption” users with equal Dynamic Priority PD performing a transition T.4 together are brought in Competition State, this cannot occur in a subsequent instant, as in the meanwhile there will
10 have been a divergence between their respective Dynamic Priority PRD values.

In the frame of the method for managing electric power consumption of a users system according to the present invention, the programming knob for starting operation of a household appliance reflects a new meaning.

Presently the consumer is able to set start time through said knob; moreover, some projects
15 at European level provide a user setting for lower consumption and operation during lower electricity rate timetables. All these approaches are intricate and uncomfortable for the consumer.

Instead of setting start time, the consumer can set the program end time, which is a closer approach to the consumer’s real requirements allowing operation optimization for the
20 users. In fact, if before the program comes to end lower power rate hours are available, the user will automatically wait till that before start operating; if, on the contrary, program end is foreseen before the lower power rate hours start, the users will simply wait for Available Power PD, while Dynamic Power PRD increases more and more in approaching activation time for the users so as to terminate the service in time. Thus, users choose autonomously
25 their optimisation principle utilizing, if possible, lower power consumption timetables though adapting themselves to the consumer’s needs.

Moreover, a laundry wash-machine may for instance activate the last water discharge and spin cycle short before the time the laundry should be ready (limiting a creasing of the

clothes).

In the instance of a refrigerator, it is important for it to learn how to operate according to the consumer's habits. Practically, it has to accumulate cold before a more frequent door opening or greater introduction of food at room temperature occurs. Door openings are
5 detected directly by the microprocessor, while food introduction (thermal load) can be detected by a temperature increase in the freezer compartment. Moreover, a refrigerator can perform defrosting at night time; night defrosting is more appropriate since a temperature increase following a defrosting operation will be less annoying; such a procedure can be favoured reducing refrigerator's Dynamic Priority during day time and
10 increasing it during the night. Such a procedure is correct, since it will make day-time defrosting less appropriate but not impossible; however, if during day time power is largely available for limiting a defrosting, it will be necessary to reduce the power usable by the refrigerator artificially. As it can be seen, a Dynamic Priority function PRD can also be used to force some users towards preferred behaviours also apart from possible conflicts
15 for the procurement of Available Power PD, i.e. Dynamic Priority PRD generally becomes a guide for a reasonable behaviour of the users wherein it is located.

The electric meter CE or measuring node NM can also send further information on environmental conditions, which cannot be detected from individual users, such as the energetic rate in force, day time, date or other useful information common for all users; in
20 fact, also the contract power rate and not only the rate may be variable with timetables, such as higher during night time and/or Summer; the electric meter CE should be able to know it in real time or from a communication of the Distribution Board or consulting a stored table associated to a clock and/or a calendar.

Overload Indication

25 As said above, the users system U is able to comply with an overload, i.e. it prevents the magneto-thermal switch from operating, it performs optimal distribution of Available Power PD, moreover each user UI is ready to start again as soon as its required power becomes available. However, some users UI have anyway to limit their consumption for a

certain time and are not favoured by it. Therefore, it is appropriate to provide means advising the consumer about the situation. The system is able to signal the situation to the consumer if one or more users are equipped with a sound and/or luminescent signal (LED or display), to be activated under overload condition, i.e. $PD < K2$ or $PD < K3$.

- 5 Alternatively, the signal may be given by the users entering a QUIESCENT State or by the users that have already spent a long time in Wait state. 2 or 3 different signals may be given according to the seriousness of the situation. By way of an orientative non limiting example:

1st signal: $PD < K2$

- 10 2nd signal: $PD < K3$

3rd signal: Users have been in Wait State for 1 hour.

Thus, the consumer can be made attentive to consumption problems and it is also possible to work on human factor to improve managing household consumptions.

Faults to the communication system from Measuring Node NM to users systems.

- 15 If no signals are received from the Measuring Node NM due to any faults or interferences, the users receiving no messages can take a maximum value for Available Power PD. Thus, the system performance is in no way worse to that of a conventional users set, also in the case of a likely faulty component.

According to the above description the features of the present invention are clear, and also
20 its advantages are clear.

In fact, the method for managing electric power consumption of a users system according to the present invention will prevent exceeding a predetermined electric power threshold globally absorbed by smart users, which adjust their consumption based on their own rules and internal information, other than on periodic information supplied by the Measuring
25 Node.

Such rules are such to advantageously exclude to have the contract power limit exceeded by a considerable value for an extremely long time, whereas if the users request it, all the available power can be substantially used and shared in an optimal way according to

priority principles.

However, advantageously, activation of a low priority household appliance is not delayed for an unlimited time and a low-priority users system can be activated if its power request is not engaged at that time.

- 5 Such a system is stable: once a users system has acquired power it can terminate its current task within a reasonable time interval, without jeopardizing its performance nor increasing its global consumption and excluding any oscillation due to equal priority users systems. Moreover, the system is advantageously a robust system, in the sense that in the worst operating conditions (such as noisy transmission means, defective component) the users
10 not affected by improper use are not inhibited and operate at least like a traditional system without behaviour rules.

Installation can be a so-called plug-and-play type, i.e. it does not require control system configurations of the users and of the measuring node. Additionally, the system is open and control algorithms are in fact independent from the number of smart users connected; each
15 user can be installed and/or removed without re-programming the Measuring Node NM or any other users.

Smart users are compatible with conventional “dummy” users (such as an iron) or other smart users that may be developed later.

The method described is extremely flexible for subsequent general behaviour amendments,
20 simply changing the criteria used to process the Available Power PD function and/or threshold power values K0, K1, K2, K3 and K4.

The behaviour of each user is flexible and it changes according to the program in course (e.g. cotton or woollens washing), program step (e.g. heating start, heating end) and program reconfiguration for terminating it with a lower power or energy consumption.

25 Moreover, access to power can be favoured during lower rate periods.

Users behaviour is conditioned by simple rules, which do not require a complex programming, though not hindering complex behaviours of the users themselves, exclusively determined by the Dynamic Priority function, whose specific calculation

procedures for each user type outline its nature.

Behaviour sophistication of individual users can be refined in time for subsequent users generations, without entailing any complications or even implying logic process reprogramming of control systems SC or of the Measuring Node NM.

- 5 As a result of such a flexibility, the system users may get to learn a consumer's habits to obtain customized management of consumptions, without any unpredictable undesired global behaviours occurring due to ensuing behaviour modifications.

It is obvious that many changes are possible for the man skilled in the art to the method for managing electric power consumption of a users system described above by way of
10 example, without departing from the novelty spirit of the innovative idea, and it is also clear that in practical actuation of the invention the components may often differ in form and size from the ones described and be replaced with technical equivalent elements.

Modifications to the behaviour diagrams and valid transitions for control systems SC of all smart users UI are also possible, in other words it is assumed for each smart user UI to
15 have the same behaviour, apart from its functional features. On the other hand, modifications to the state transitions are possible in the frame of the present invention, which have a restricted application for some particular smart users.

For instance, a QUIESCENT State is appropriate for warranting the system stability, but it can be eliminated in some instances or for some users. A refrigerator generally has a very
20 low consumption (about 200 W) though it may absorb 10-12 Amp in less than one second. Since this consumption has an extremely short duration in time, its activation during a thermalization step of the oven or any temporary window with the required power available would not cause any problem. An analogous situation occurs for a laundry wash-machine or dishwasher requiring power for a very short time, about one minute as just
25 required to bring temperature from 27°C to 40°C. In these cases the QUIESCENT State can be avoided and a user loosing in a competition stage will go directly over to wait state. By way of a further example, a laundry wash-machine may have a very low Dynamic Priority when starting operation; if there is an overload, it may probably happen that the

washing machine is unable to start heating and remains at standstill with the laundry and soapy water in the tub. Such a situation, if extended in time, may increase clothes wear; therefore, it would be appropriate for the washing machine to verify if Available Power PD is sufficient to activate the heater before taking water in. In the negative, it will go
5 directly to the Wait state without going through competition.

CLAIMS

1. A method for managing electric power consumption of a users systems, said users system comprising:
 - a set of users (U), comprising in turn a set of smart users (UI) equipped with control systems (SC), said set of users (U) being operatively connected to a power supply network (RE);
 - power measuring means (CE, NM), capable of transmitting information on power consumption (PD) to said control systems (SC);where the control systems (SC) perform power consumption control of the associated smart user (UI) on the basis of information on power consumption (PD) transmitted by the power measuring means (CE, NM) by the power measuring means (CE, NM), characterized in that each control system (SC) performs power consumption control of the associated smart user (UI) on the basis of the information on power consumption (PD) and of information on the state of the associated smart user (UI) obtained from the control system itself (SC), said information on power consumption (PD) and state information (PriorEff) of the smart user (UI) being processed for determining a priority (PriorEff), so as to establish right for the associated smart user (UI) to the consumption of power packets (ΔP) available from the power supply network (RE).
2. A method for managing electric power consumption of a users systems according to claim 1, characterized in that it employs said priority (PriorEff) as a starting value allocated to each respective smart user (UI) in a competition procedure (S.2, S.6, S.7) within the set of smart users (UI).
3. A method for managing electric power consumption of a users systems according to claim 2, characterized in that said priority (PriorEff) is made variable in time as a function of state information (PRD).
4. A method for managing electric power consumption of a users systems according to claim 3, characterized in that said priority (PriorEff) is obtained based on a Dynamic

Priority (PRD) value, which is part of the state information of the smart user (UI).

5. A method for managing electric power consumption of a users systems according to claim 4, characterized in that said priority (PriorEff) is employed for controlling time counting means (YP), which cause the value of said priority (PR) to evolve for performing a competition procedure (S.2, S.6. S.7).
6. A method for managing electric power consumption of a users systems according to claim 5, characterized in that in line with determined values taken by the information on Power Consumption (PD), the system control (SC) goes over to a Competition for Increment State (S.2, S.6), reducing energy consumption at the same time.
7. A method for managing electric power consumption of a users systems according to claim 6, characterized in that in said Competition for Increment State (S.2, S.6), the control system (SC) evaluates Power Consumption (PD) information at the end of Priority evolution (PriorEff) dictated by the time counting means (TP) to establish subsequent transitions (T.2, T.3, T.4, T.16, T.20, T.21, T.22, T.23).
8. A method for managing electric power consumption of a users systems according to claim 7, characterized in that said subsequent transitions (T.2, T.3, T.4, T.16, T.20, T.21, T.22, T.23) are also established based on power threshold values (K0, K1, K2, K3, K4, K5) stored in the control system (SC).
9. A method for managing electric power consumption of a users systems according to claim 8, characterized in that said power threshold values ((K0, K1, K2, K3, K4, K5) are adjustable.
10. A method for managing electric power consumption of a users systems according to claim 8, characterized in that said power threshold values (K0, K1, K2, K3, K4, K5) can be adjusted individually for each smart user (UI).
11. A method for managing electric power consumption of a users systems according to claim 7, characterized in that subsequent transitions comprise taking (T.2, T.22) a packet of available power (ΔP) from the supply network (RE).
12. A method for managing electric power consumption of a users systems according to

claim 7, characterized in that subsequent transitions comprise a transition (T.3) in a QUIESCENT State (S.4)

13. A method for managing electric power consumption of a users systems according to claim 12, characterized in that in said QUIESCENT State (S.4) priority (PriorEff) is
5 reset and subsequently incremented at constant rate.
14. A method for managing electric power consumption of a users systems according to claim 2, characterized in that power consumption of a smart user (UI) is reduced through deactivation.
15. A method for managing electric power consumption of a users systems according to
10 claim 6, characterized in that in line with second determined values taken by the information on power consumption ($PD < K2$) the control system (SC) goes over to a Competition for Decrement State (S.2), so as to reduce energy consumption.
16. A method for managing electric power consumption of a users systems according to claim 15, characterized in that in said Competition for Decrement state (S.6) time
15 counting means (TP) cause the priority (PriorEff) to evolve in an opposite direction to the evolving of the Competition for Decrement State (S.7).
17. A method for managing electric power consumption of a users systems according to claim 15, characterized in that in said Competition for Decrement State (S.6) a user (UI), whose time counting means (TP) reach count end, may choose to execute a
20 transition (T.14) wherein a power packet (ΔP) is released).
18. A method for managing electric power consumption of a users systems according to claim 5, characterized in that in line with determined information values about available power (PD), the users (UI) having a priority (PriorEff) below a fixed threshold are immediately deactivated.
- 25 19. A method for managing electric power consumption of a users systems according to claim 5, characterized in that in line with determined information values on Available Power (PD), the users (UI) with a priority (PriorEff) below a threshold associated to available power (PD) information are immediately deactivated.

20. A method for managing electric power consumption of a users systems according to claim 2, characterized in that the control system (SC) of each smart user (UI) is allowed to use Reduced Load strategies and/or Reduced Consumption strategies.
21. A method for managing electric power consumption of a users systems according to one of the previous claims, characterized in that each smart user (UI) takes dynamic priority values (PRD) differing from the values of each other smart user (UI) to hinder the set of users (UI) from entering oscillation situations.
22. A method for managing electric power consumption of a users systems according to one of the previous claims, characterized in that each smart user (UI) draws a power packet (ΔP) in a different instant to hinder the set of users from entering oscillation situations.
23. A method for managing electric power consumption of a users systems, where each user has an associated priority (PriorEff) for access to energy consumption, characterized in that said priority (PriorEff) is used to initialise a timer (TP) in a proportional mode to said priority (PriorEff) and let the user (UI), whose relevant timer (TP) will first terminate its own count, have access to energy consumption.
24. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that the Priority Timer (TP) is obtained through a counter employing a higher number of bits than the number of bits employed for defining the priority (PriorEff).
25. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that it uses the most significant bits (P8 ... P1) of the Priority Timer (TP) for representing the priority (PriorEff) and the less significant bits (I3, I2, I1) for a second temporary scansion.
26. A method for managing electric power consumption of a users systems, where each user (UI) is associated to a priority (PriorEff, PRD) for access to energy consumption, characterized in that each smart user (UI) is provided to autonomously define its own Dynamic Priority (PRD) as a function of the operating state of the user

(UI) itself and environment information.

27. A method for managing electric power consumption of a users systems according to the previous claim, characterized in that dynamic priority (PRD) is defined as a function of information, such as user service duration and/or program in course
5 and/or a program step and/or remaining time to end the step and/or possible program reconfiguration to request less power and/or consumer's habits and/or timetable for service to end and/or electric low-rate timetables.
28. A method for managing electric power consumption of a users systems according to claim 26 or 27, characterized in that Dynamic Priority (PRD) is determined through
10 elaboration circuits operating according to fuzzy logic principles.
29. A users' system comprising a set of users (U), which comprises in turn a set of smart users (UI), with control systems (SC), said set of users (U) being operatively connected to an energy supply network (RE) and comprising, moreover, energy measuring means (CE, NM) apt to transmit information on energy consumption (PD)
15 to said control systems (SC), where said control means (SC) perform autonomously energy consumption control of the associated smart user (UI) based on the information on energy consumption (PD) transmitted by the energy measuring means (CE, NM), characterized in that said control system (SC) comprises means (TB6, TB7, TB8) for processing a priority value (PRD).
- 20 30. A users system according to claim 26, characterized in that the control system (SC) comprises time counting means (TP) for performing a count based on the priority value (PRD).
31. A users system according to the previous claim, characterized in that the control system (SC) comprises logic fuzzy elaboration circuits for determining the dynamic
25 priority (PRD) value.
32. A users system according to the previous claim 26, characterized in that said control system (SC) is associated to sound and/or visual displaying means to signal information on energy consumption (PD).

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Fig. 1

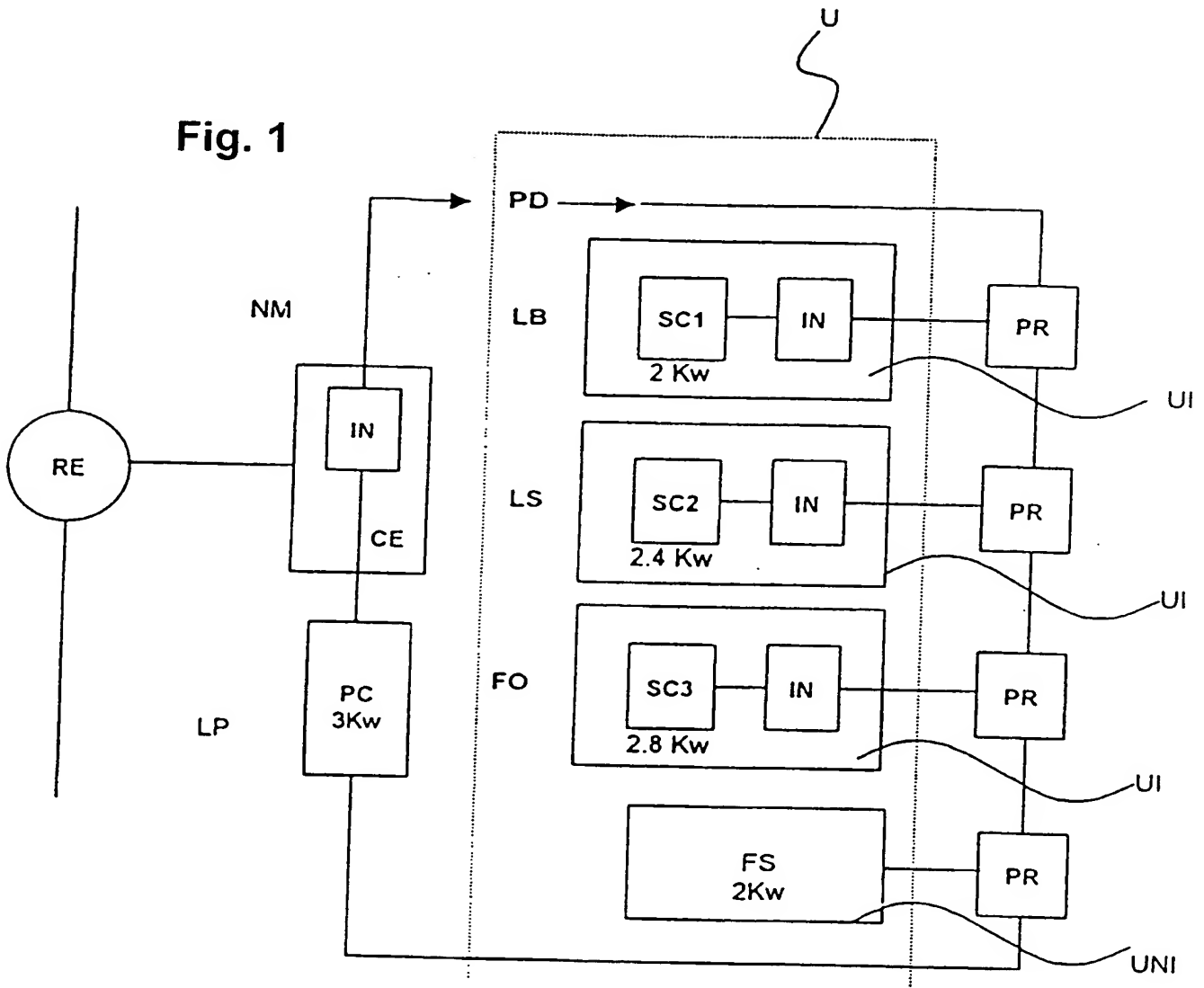
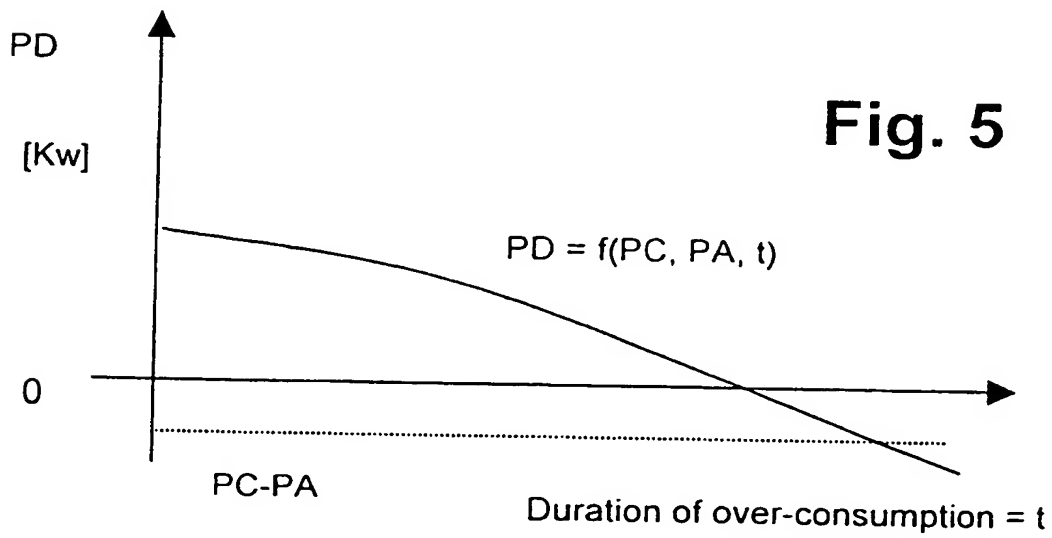


Fig. 5



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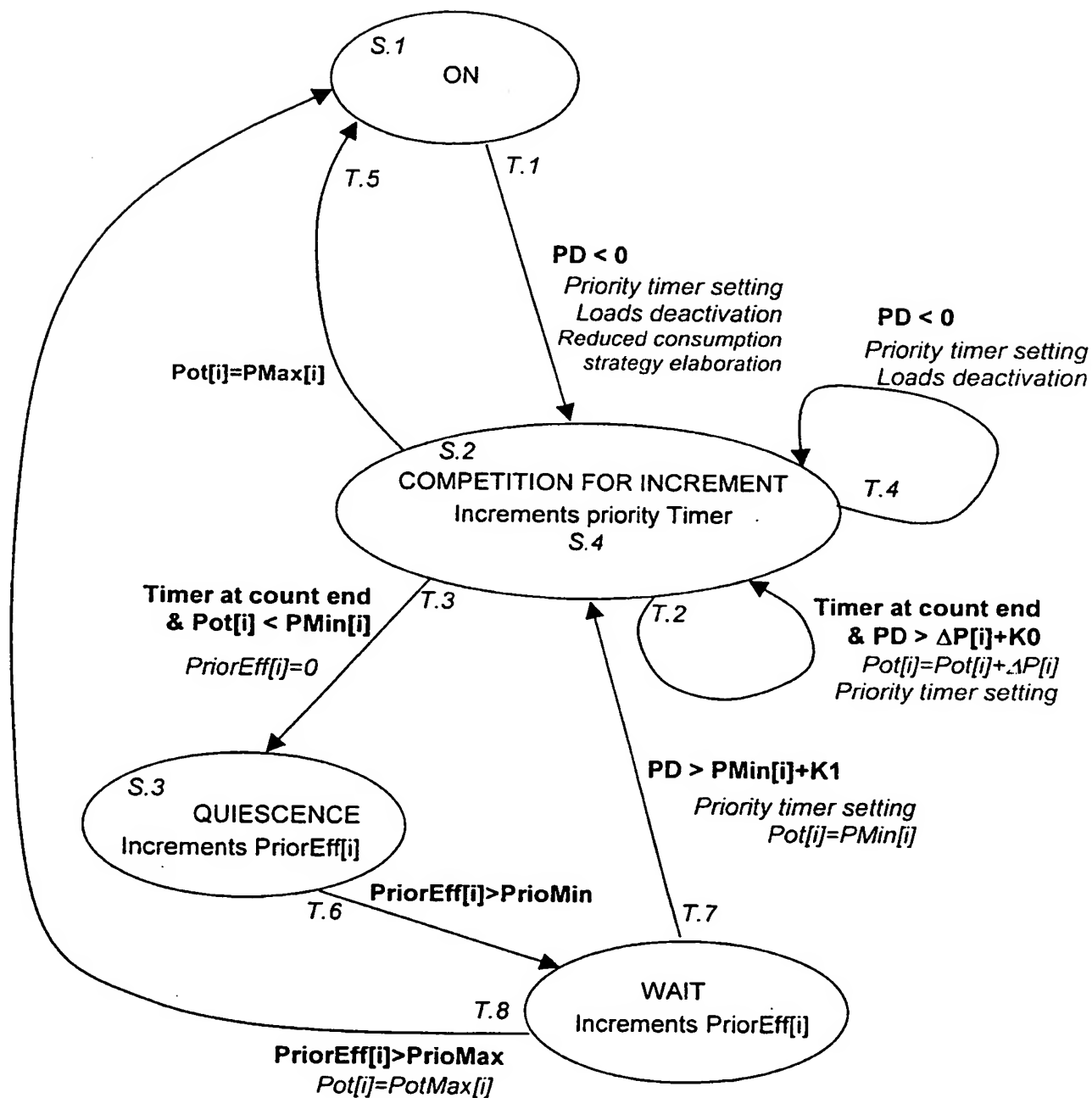
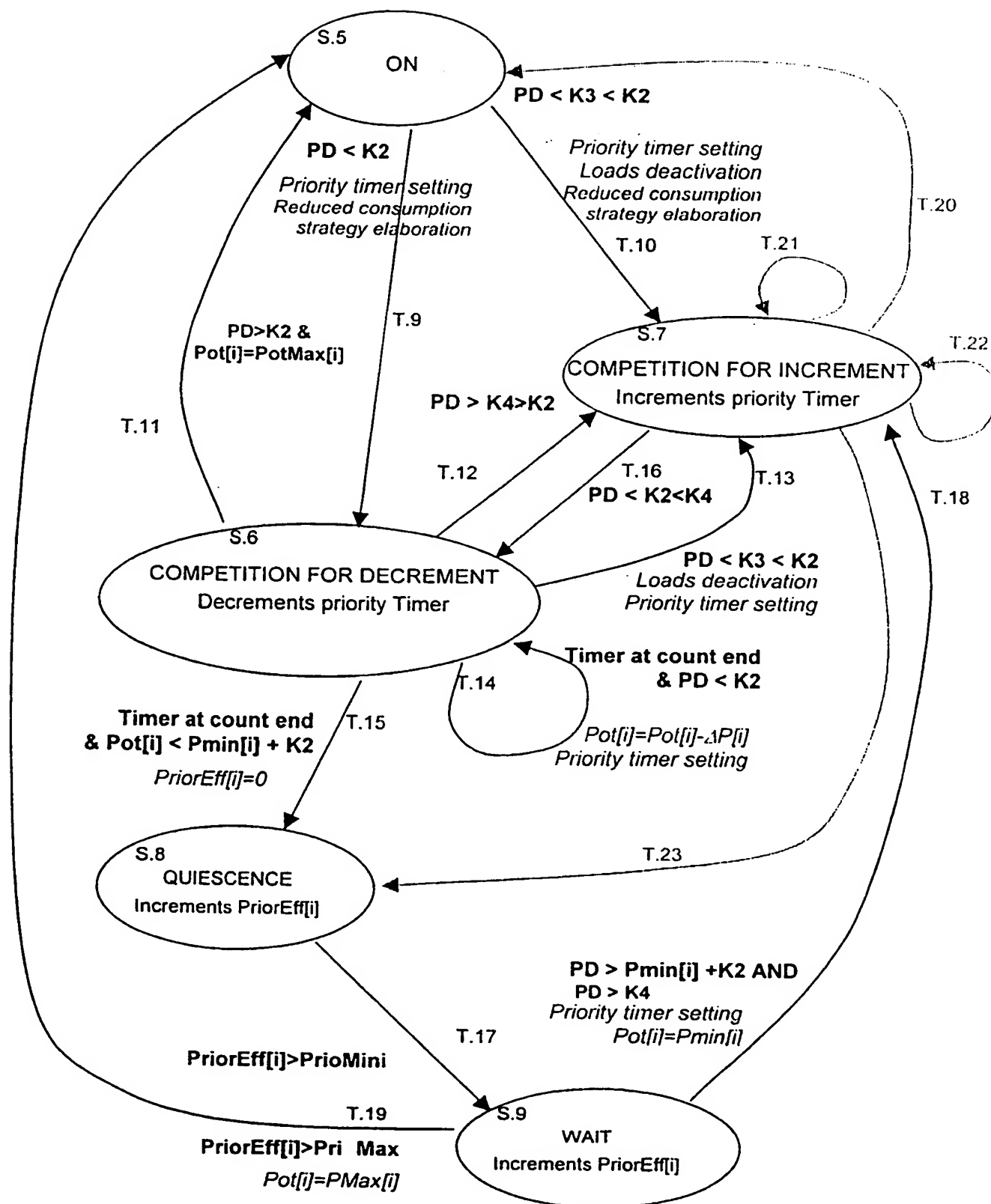


Fig. 2

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Fig. 3



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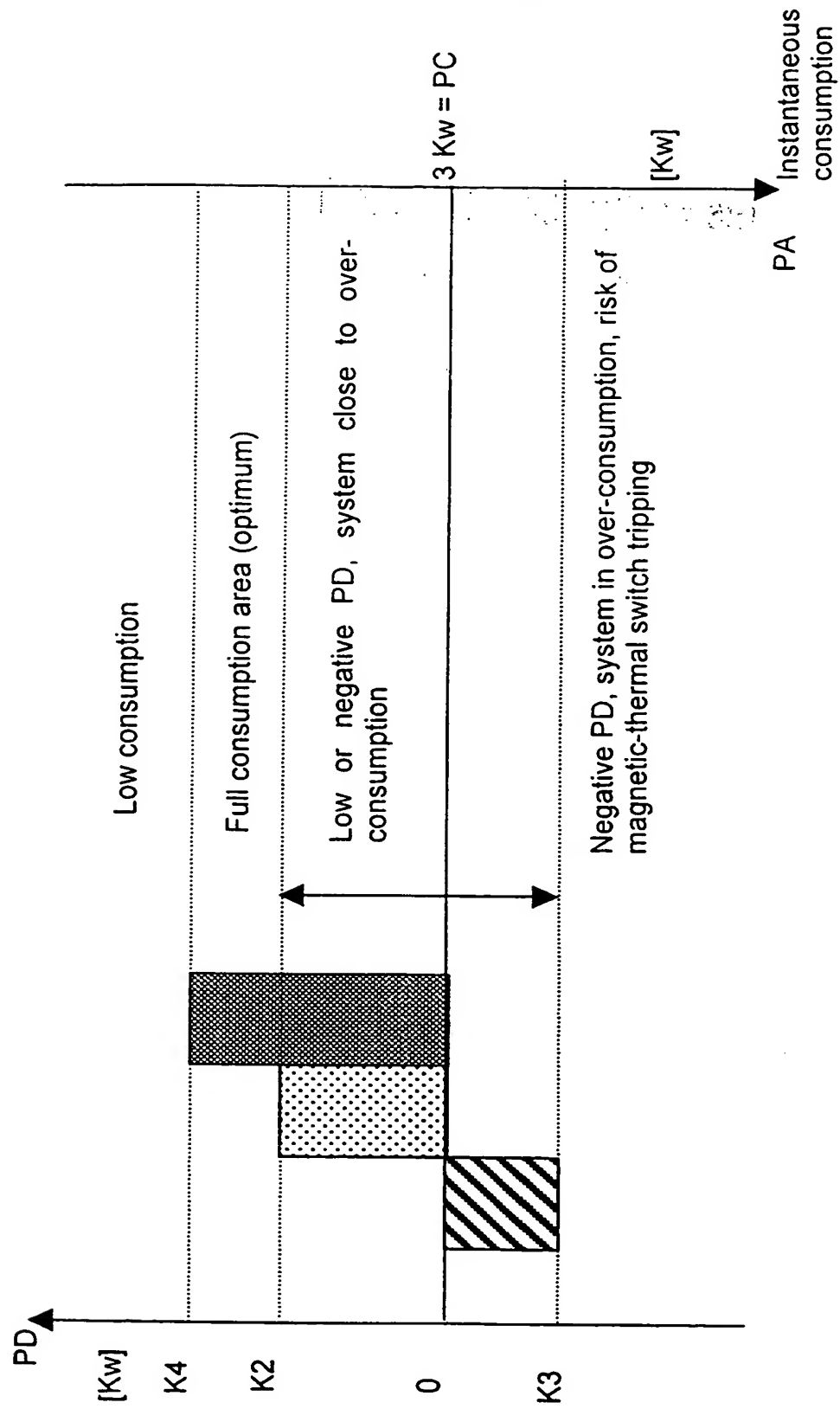


Fig. 4

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Dynamic priority PRD: functions of output	PRD Low	PRD Medium	PRD High
Laundry washer	40	70	105
Oven	60	100	120
Refrigerator	20	65	125

TB6

Fig. 6

<i>If the programme is woolen and the time still due to the end of heating is short, then medium priority</i> <i>If the programme is cotton and the time still due to the end of heating is short, then low priority</i>

TB7

Fig. 7

Dynamic priority PRD: functions of output	PRD Low	PRD Medium	PRD High
Cotton	40	70	100
Synthetics	40	80	110
Woolen	80	100	120

TB8

Fig. 8

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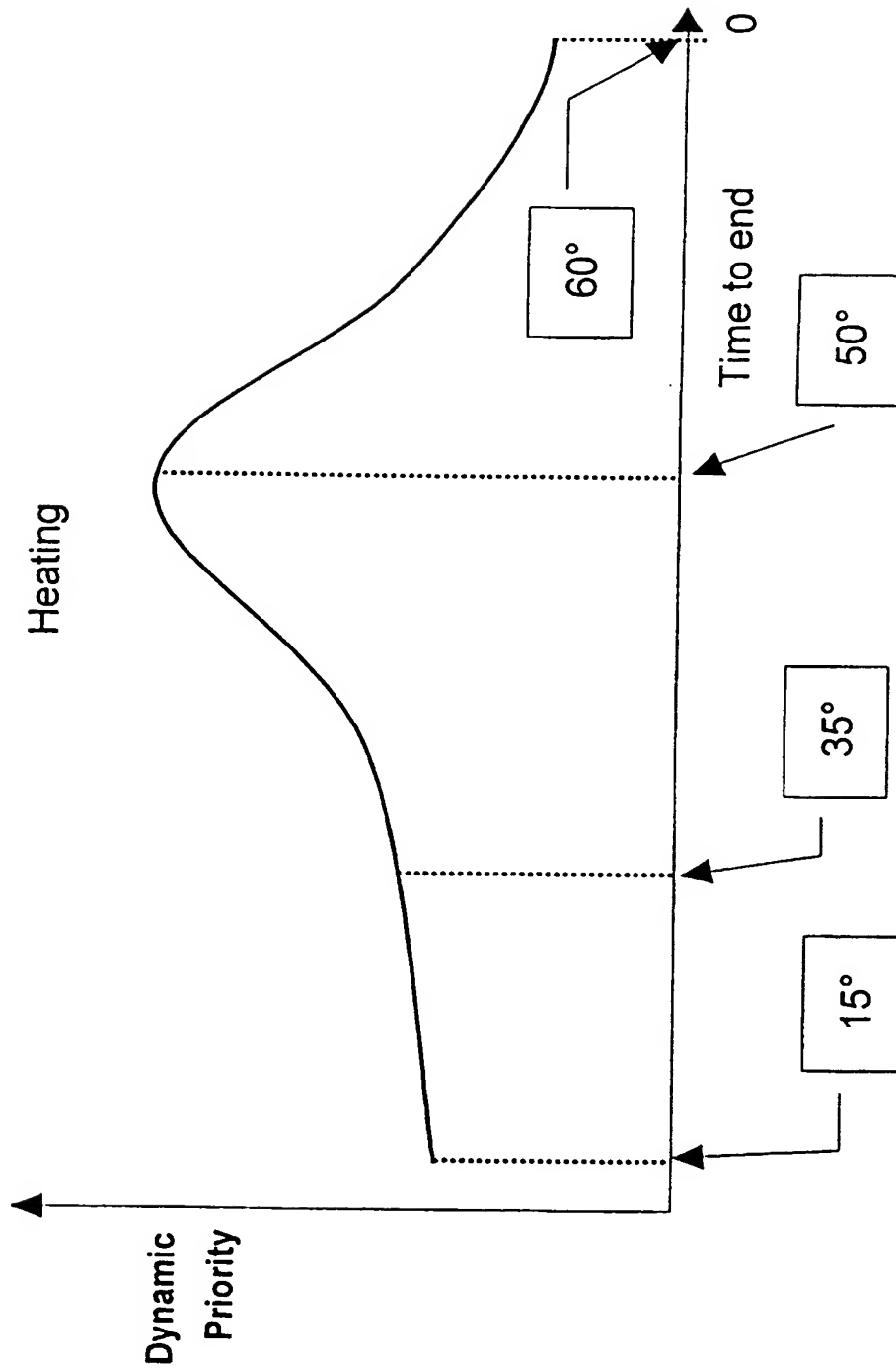


Fig. 9

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TP

P8	P7	P6	P5	P4	P3	P2	P1	0	0	0	0	0	0	0	0
Priority bit								Address bit							

Fig. 10

TP

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Priority bit								I3	I2	I1	1	1	1	1	1
								Address bit							

Fig. 11

TP

P8'	P7'	P6'	P5'	P4'	P3'	P2'	P1'	0	0	0	0	0	0	0	0
Priority bit								Address bit							

Fig. 12

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 00/00097

A. CLASSIFICATION OF SUBJECT MATTER

H02J3/14, H02J3/46, H02J13/00

According to International Patent Classification (IPC) or to both national classification and IPC 7

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 19530826 C (BRÜDERL ET AL.) 23 January 1997, column 5, line 27 - column 7, line 17.	1, 4, 14
A	---	18, 19, 26, 27, 29
Y	US 4620283 A (BUTT ET AL.) 28 October 1986, column 5, line 9 - column 9, line 37, claims 1, 10.	1, 14
A	---	2, 4, 5, 18, 19, 26, 29

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents:

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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- *G* document member of the same patent family

Date of the actual completion of the international search

12 May 2000

Date of mailing of the international search report

22 08. 2000

Name and mailing address of the ISA

European Patent Office, P.O. 5818 Patentlaan 2
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MEHLMAUER e.h.

INTERNATIONAL SEARCH REPORT

Internat.

Application No

PCT/IB 00/00097

-2-

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	--	18, 19, 26, 29
A	US 5543667 A (SHAVIT ET AL.) 06 August 1996, column 9, line 41 - column 10, line 49, claim 1 (cited in the application).	1, 14, 19, 29
A	US 5481140 A (MARUYAMA ET AL.) 02 January 1996, column 6, line 15 - column 7, line 61, claims 1,2,4,9,10.	1, 2, 14, 18, 19, 26, 29
A	Patent Abstracts of Japan, vol.9708, no.12(035), 25 December 1997; & JP 09 215193 A (NTT) 15 August 1987, abstract.	1, 14, 19, 29, 32

ANHANG

Zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

ANNEX

To the International Search Report to the international Patent Application No.

PCT/IB 00/00097 SAE 269409

This annex lists the patent family members relating to the patent documents cited in the above-mentioned search report. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

ANNEXE

Au rapport de recherche international relatif à la demande de brevet international n°

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visée ci-dessus. Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l' Office.

Im Recherchenbericht angeführte Patentdokumente Patent document cited in search report Document de brevet cité dans le rapport de recherche			Datum der Veröffentlichung Publication date Date de publication		Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets		Datum der Veröffentlichung Publication date Date de publication	
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					EP	B1	538078	27-05-1998
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